7/1/03-02182

Final
Remedial Investigation/Feasibility Study
Work Plan
for
Solid Waste Management Unit (SWMU) 6, SWMU 7, Area of Concern (AOC) H, and AOC J
Former U.S. Naval Ammunition Support Detachment
Vieques Island, Puerto Rico

Prepared for

Department of the Navy
Atlantic Division
Naval Facilities Engineering Command

Under the
LANTDIV CLEAN II Program
Contract No. N62470-95-D-6007
CTO-248

Prepared by

CH2MHILL

Tampa, Florida

July 2003

E062003003TPA

Executive Summary

This work plan presents proposed new Remedial Investigation (RI)/Feasibility Study (FS) sampling activities and their locations at four sites identified within the Former Naval Ammunition Support Detachment (Former NASD) located on western portion of Vieques Island, Puerto Rico. The four sites are Solid Waste Management Unit (SWMU) 6, SWMU 7, Area of Concern (AOC) H, and AOC J. These four sites were previously investigated as part of the Expanded Preliminary Assessment/Site Investigation (PA/SI), and PA/SI Phase II reports. Analytical results from these investigations indicated a need for further investigation at these four sites. Therefore, additional data collection is proposed as part of this RI/FS effort to further characterize the sites and define the nature and extent of contamination in site media.

The results of this sampling effort, as well as the previous data from the two PA/SIs, will be included in preparing a remedial investigation (RI) report, which will also include a human health and ecological risk assessment (HH&ERA). Based on the risk assessment results, the site may be recommended for further actions through a feasibility study (FS), following EPA guidance conducting an RI/FS. Remedial goal options will be developed at the end of the RI, and beginning of the FS for sites requiring further action. Based on the sites and media requiring further action, remedial action objectives (RAOs) will be developed and an alternatives analysis will be conducted. A recommended action will follow upon review of the proposed alternatives. If risk assessment results indicate no need for further evaluation, no further action will be recommended for each for these sites at the end of RI report.

A Munitions and Explosives of Concern (MEC) avoidance survey by a qualified team will be performed at SWMU 6, SWMU 7 and AOC J. A geophysical survey of the waste and rubble areas will also be conducted using electromagnetic methods (non-intrusive) survey techniques at SWMU 6, SWMU 7, and AOC J. A magnetometer survey was already conducted at SWMU 6, but additional data will be collected along the eastern boundary of the site.

Section 4 of the report includes a detailed discussion of the previously collected samples and the proposed samples for these four RI sites. These sites ranged in size from less than 0.5 acre to 1.2 acres. Considering the small area occupied by these sites, the previously collected data and the samples proposed in this work plan represent an adequate database to develop a clear understanding of the site conditions. The number of samples at the end of this RI will be adequate for statistical average estimations recommended by EPA guidance for risk assessments. The spatial distribution of the samples is designed to cover the potential migration pathways identified in the site conceptual models (CSMs) presented in Section 3. The analytical parameters proposed for the new samples are selected based on previous sampling results from the PA/SIs.

The data quality evaluation (DQE) will follow existing EPA and Navy guidelines, and the analytical data will be validated and qualified prior to use in the HH&ERA.

The proposed ecological risk assessment will follow EPA guidance. Environmental sampling (i.e., soil, sediment, and surface water samples) will determine the potential for ecological risks to be above acceptable levels. If the results indicate a need for further biological sampling, a recommendation for further investigation will be made according to the EPA guidance as described in Section 5.

The following paragraphs present site-specific history, site conditions, and summarizes the proposed new sampling activities.

SWMU 6 – Mangrove Disposal Site

SWMU 6, also known as the Mangrove Disposal Site, is the former location of a known base disposal area in use during the 1960s and 1970s. The Phase I Expanded PA/SI completed at SWMU 6 investigated soils, groundwater, surface water and sediments in May 2000. The PA/SI Report recommended the site for a full RI/FS to evaluate the extent of the polychlorinated biphenyl (PCB) distribution, as well as a human health and ecological risk estimation for the detected PCBs, benzo(a)pyrene, and pesticides (CH2M HILL, October 2000). The well in which PCBs were detected was re-sampled, and the data did not indicate detectable levels of PCBs (see Appendix F).

For this RI/FS, additional sampling and geophysical surveying will be conducted to further characterize the site. Four new wells will be installed in addition to the four existing monitoring wells as described in Section 4 of this work plan. Fifteen surface soil samples and fifteen subsurface soil samples will be collected across the landfill and to the east of the geophysical survey area of the site to determine the nature and extent of the disposed waste. Nine surface water samples will be collected from five of the seven previous sampling locations and four new locations. Fourteen new sediment samples will be collected, including four samples from previously sampled locations and two background samples. Tidal effects will also be investigated at this site. Two background sediment and surface water samples will be collected from an adjacent surface water body. A geophysical survey using electromagnetic methods will be conducted to better define the eastern boundary of the site. MEC avoidance will be conducted during the geophysical survey, the installation of monitoring wells and soil borings, and the collection of soil samples.

SWMU 7 – Former Quebrada Disposal Site

SWMU 7, also known as the Former Disposal Site, used to be referred to as Quebrada Disposal Site. It is the former location of a landfill used between the early 1960s and late 1970s. The *Expanded PA/SI Field Investigation for SWMU 7* (CH2M HILL, April 2000) included groundwater, surface soil, and sediment sampling. Parameters exceeding the screening criteria included metals in groundwater, while metals and benzo(a)pyrene exceeded criteria in surface soils. A full RI/FS and risk assessment was recommended for SWMU 7 to determine the extent of contamination in surface soil and groundwater.

The proposed work for the RI/FS at this site includes performing a geophysical survey, installation of five new monitoring wells, sampling of new and existing monitoring wells, and collection of fifteen surface soil and eleven subsurface soil samples. Two sediment samples will be collected if standing water is observed in the downstream end of the ditch. MEC avoidance will be conducted during the installation of monitoring wells and soil

borings and the collection of soil samples. The sampling plan is described in detail in Section 4 of this work plan.

AOC H –Former Power Plant

AOC H, also known as the Former Power Plant, operated from 1941 to 1943. From the 1960s to the 1980s, Navy personnel used the building for fire training operations. During the Phase II PA/SI field investigation, soil and groundwater samples were collected (CH2M HILL, December 2000). A full RI/FS was recommended at AOC H to delineate the extent of explosives, pesticides, and semi-volatile organic compounds (SVOCs) detected in surface soils at the site at concentrations found above the USEPA Region IX screening criteria.

The proposed work for the RI/FS at this site includes installation and sampling of three new monitoring wells. Also, two existing wells will be sampled. Additionally, thirteen new surface soil and thirteen subsurface soil samples, five surface water samples, and five sediment samples will be collected. These are described in more detail in Section 4 of this work plan.

AOC J – Former Staging Area Disposal Site

AOC J, also known as the Former Staging and Disposal Site, encompasses an area of approximately 1.2 acres. The site accepted solid wastes associated with construction staging activities from the mid-1960s until it closed in 1973. Most debris from this site was removed and placed in a municipal landfill. Remaining piles of debris were still visible when the site was recently investigated. The PA/SI field activities determined that a full RI/FS was needed to define the extent of perchlorate and metals identified in groundwater above the USEPA Region IX Preliminary Remedial Goals (PRGs). MEC avoidance investigation also was recommended because several UXO items were found at this site.

The proposed work for the RI/FS at this site includes performing a geophysical survey, conducting a MEC Avoidance survey, installing five new monitoring wells, collecting samples from existing and newly installed monitoring wells, and collecting five surface and five subsurface soil samples from five soil borings, and six each of co-located sediment and surface water samples. These activities are described in more detail in Section 4 of this work plan.

Contents

List of Appendixes

List of Tables

List of Figures

Number **Page**

List of Acronyms

AWQC	Ambient water quality criteria
AOC	Area of concern
ARAR	Applicable or relevant and appropriate requirement
AST	Aboveground storage tank
ASTM	American Society for Testing and Materials
bls	Below land surface
CDI	chronic daily intake
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cfm	Cubic feet per minute
CLP	Contract laboratory program
COC	Chain-of-custody
COPC	Contaminant of potential concern
CRP	Community relations plan
CSM	Conceptual site model
DO	dissolved oxygen
DOI	Department of the Interior
DOT	Department of Transportation
DQE	Data quality evaluation
DQO	Data quality objectives
DRO	Diesel range organics
DV	Data validation
EBS	Environmental baseline survey
ECOSD	ecological screening values for sediment
EDD	electronic data deliverable
EM	electromagnetic
EPC	exposure point concentration
ERA	ecological risk assessment
ERM	Environmental Resources Management Group
ESE	Environmental Science and Engineering, Inc.
FSP	Field sampling plan
GAC	Granular Activated Charcoal Adsorption
GIS	Geographical information system
GPS	Ground positioning satellite
GRO	Gasoline range organics
HASP	Health and safety plan
HHERA	Human health and ecological risk assessment
HI	health indices
HMO	hydrous manganese oxide

HQ	Hazard Quotient
IAS	Initial Assessment Study
IC	Institutional controls
IDW	Investigation-derived waste
IDWP	Investigation-derived waste plan
IR	Installation restoration
LANTDIV	Atlantic Division
LCS	Laboratory confirmation sample
LPAS	Low-profile air stripper
MCL	Maximum contaminant level
MDL	Method detection limit
MEC	Munitions and Explosives of Concern
MPE	Multi-phase extraction
mg/kg	Milligrams per kilogram
MS/MSD	Matrix spike/matrix spike duplicate
msl	Mean sea level
NAPL	Non-aqueous phase liquid
NASD	Naval Ammunition Support Detachment
NOAA	National Oceanic and Atmospheric Administration
NSRR	Naval Station Roosevelt Roads
OA	ordnance avoidance
OE	Ordnance and Explosives
OVA	Organic vapor analyzer
OVM	Organic vapor meter
PAH	Polynuclear aromatic hydrocarbons
PARCC	Precision, accuracy, representativeness, completeness, and comparability
PA/SI	Preliminary Assessment/Site Investigation
PCB	Polychlorinated biphenyls
PQL	practical quantitation limit
PREQB	Puerto Rico Environmental Quality Board
PRG	Preliminary Remedial Goal
PRL	Potential release location
PVC	Polyvinyl chloride
PWC	Public Works Compound
QAPP	Quality assurance project plan
QA/QC	Quality assurance/quality control
QRA	Qualitative risk assessment
RA	Risk assessment
RAGS	Risk assessment guidance for Superfund
RAO	Remedial action objectives
RBC	Risk-based concentration
RCRA	Resource Conservation and Recovery Act

RFI	RCRA Facility Investigation
RFP	Request for Proposals
RGO	remedial goal option
RI/FS	Remedial investigation/feasibility study
SC	Site characterization
SMDP	scientific management decision point
SOP	Standard operating procedures
SOW	Scope of work
SVE	Soil vapor extraction
SVOC	Semi-volatile organic compound
SWMU	Solid Waste Management Unit
TEF	toxicity equivalency factors
TM	Technical Memorandum
TRC	Technical Review Committee
TPH	Total petroleum hydrocarbons
TRPH	Total recoverable petroleum hydrocarbons
UCL95%	95 Percent Upper Concentration Limit
USEPA	U.S. Environmental Protection Agency
UST	Underground storage tank
USTMD	Underground storage tank management division
UXO	Unexploded Ordnance
VOA	Volatile organic aromatic
VOC	Volatile organic compound
ZVI	zero-valent iron
µg/L	Micrograms per liter

SECTION 1

Introduction

This Work Plan presents the investigation rationale and technical approach for sampling analysis and data evaluation as part of the Remedial Investigation/Feasibility Study (RI/FS) to be conducted at four of the sites located within the former Naval Ammunition Support Detachment (NASD) in Vieques, Puerto Rico. The location of the former NASD is shown in Figure 1-1. The scope of this RI/FS work plan is based on previous investigations conducted at the Solid Waste Management Unit (SWMU) 6, SWMU 7, Area of Concern (AOC) H, and AOC J sites within the Former NASD. Site locations are shown in Figure 1-2. These investigations were coordinated with the U.S. Environmental Protection Agency (USEPA) Region 2 and the Puerto Rico Environmental Quality Board (PREQB). A summary of previous site investigations is included in Section 2, Site Background and Physical Setting. Aerial photographs of SWMU 6, SWMU 7, AOC H, and AOC J are shown in figures 1-3, 1-4, 1-5, and 1-6, respectively.

The four sites initially were investigated as part of the Expanded Preliminary Assessment/site Investigation (PA/SI) and Phase II Expanded PA/SI (CH2M HILL, 2000a and 2002b). Data were also collected from two of the sites (SWMUs 6 and 7) during an earlier Confirmatory Sampling (CS) investigation in 1988. All the available data up to now and site related potential migration and exposure pathways were taken into account in proposing the current RI/FS sampling.

Proposed work for the RI/FS at the four sites includes performance of a Munitions and Explosives of Concern (MEC) Avoidance survey, collection of soil samples, installation of new monitoring wells, and sampling of new and existing monitoring wells, and collection of sediment and surface water samples. These activities are described in more detail in Section 4 of this work plan.

This Work Plan provides a general description of the tasks to be performed to complete the investigation phases as part of the RI/FS for each site. Detailed descriptions of sampling equipment, analysis procedures, quality assurance protocols, health and safety requirements, and community relations planning procedures are addressed fully in the facility-wide Master Work Plan for the Former NASD (CH2M HILL, January 2001). This information is not repeated in the present work plan. The Master Work Plan includes the following six plans, which are common to all work performed within the Former NASD:

- Project Management Plan
- Master Quality Assurance Plan
- Data Management Plan
- Health & Safety Plan
- Investigation Derived Waste Management Plan
- Community Relations Plan

Therefore, this related information is not repeated in this work plan. The health and safety plan for the work to be performed as part of the RI/FS at these four sites, however, is included in Appendixes D and E. Screening criteria are included in Appendix G.

1.1 Objectives of the RI/FS at the Four Sites

The RI/FS will be completed in accordance with the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and will follow the interim final *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (USEPA, October 1988).

The primary objectives of the RI/FS at the four sites located within the Former NASD include:

- A field data collection program further defining the extent and magnitude of contamination present in the soils, groundwater, surface water, and sediment
- An RI report that includes both human health and ecological risk assessments for each site based on land use assuming baseline conditions at the four sites
- An FS that will include development and evaluation of remedial action alternatives, if or when unacceptable risks to human health or the environment are identified

If the RI determines that unacceptable risks to human health or the environment exist, the FS will evaluate remedial action alternatives to minimize potential exposure to existing site contaminants.

1.2 Organization of the Work Plan

The present RI/FS Work Plan is organized as follows:

Section 1, Introduction, provides general background information regarding the RI/FS, summarizes the purpose of the investigation, and presents the expected results or goals of the RI/FS sites at the Former NASD.

Section 2, Site Background and Physical Setting, describes the location and environmental history of the facility, discusses previous investigations, and provides information concerning the physical settings of the sites.

Section 3, Initial Data Evaluation and Conceptual Site Models, presents the conceptual site models developed during the project-scoping phase, which describe the potential migration and exposure pathways of site contaminants. This section also summarizes the preliminary assessment of human health and environmental impacts from site-related activities.

Section 4, Remedial Investigation Technical Approach and Investigation Procedures, provides a description of number of samples and their locations within each site, and the purpose of the proposed sampling. These descriptions include site-specific RI site characterization tasks adapted from the detailed tasks identified in the Quality Assurance Project Plan (QAPP) and the Field Sampling Plan (FSP) of the Master Work Plan.

Section 5, Human Health and Ecological Risk Assessment (HH&ERA), describes the objectives of the HH&ERA process that will be incorporated into the RI report for the Former NASD and summarizes the HH&ERA components, including contaminant identification, exposure assessment, toxicity assessment, and risk characterization.

Section 6, Preliminary Identification of Generic Remedial Action Alternatives, describes the remediation action objectives (RAOs) and remedial goals for the four sites.

Section 7, Remedial Investigation/Feasibility Study Report, describes the general outline of the RI/FS report.

Section 8, Schedule, presents the anticipated RI/FS schedule for the Former NASD based on the scope of the project, and identifies key activities and delivery dates.

Section 9, Project Management, summarizes the project management component of the program, which defines the relationships and responsibilities for selected task and project management items. This section also provides a listing of personnel who will be part of the NASD RI/FS team.

Section 10, References, presents a listing of works referenced during compilation of the RI/FS Work Plan for the Former NASD.

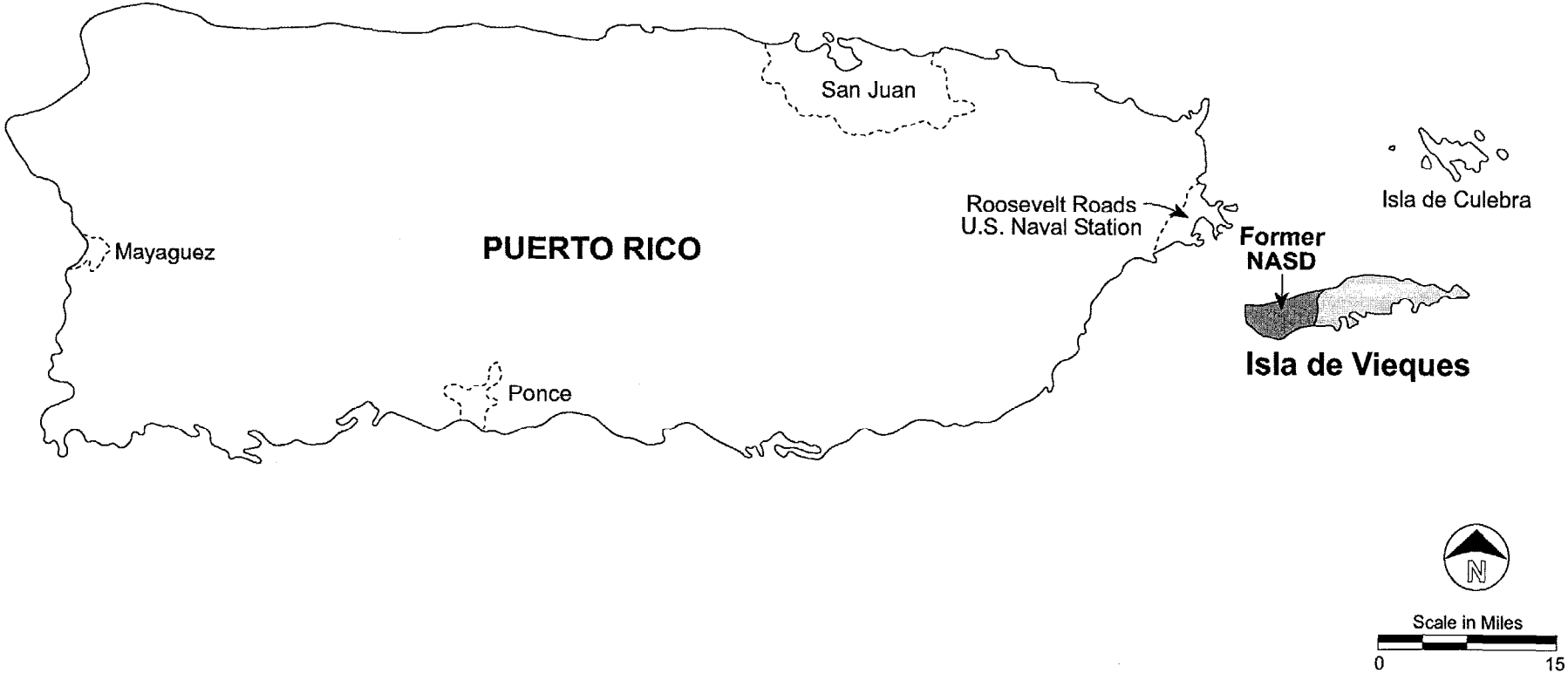


Figure 1-1
SITE LOCATION MAP
Former NASD, Vieques Island, Puerto Rico

CH2MHILL

Figure 1-2
FACILITY LOCATION MAP
Former NASD, Vieques Island, Puerto Rico

CH2MHILL

02182D014

T:\Environmental\Puerto Rico Drawings\Vieques\Former NASD\Drawings—NASD\Site Location—Fig 1-2.dwg

SECTION 2

Site Background and Physical Setting

This section summarizes the available information on the Former NASD sites to be investigated further under this RI/FS work plan. This information was obtained from previous reports prepared for these sites, and includes subsections describing the site setting, the regional and site-specific geology and hydrogeology, and summaries of previously completed investigations.

2.1 Site Setting

2.1.1 SWMU 6 – Mangrove Disposal Site

The Mangrove Disposal Site is located in a 1-acre ocean-side mangrove swamp in Laguna Arenas along State Route 200 on the Former NASD (Figure 2-1). The site was used during the 1960s and 1970s as a disposal area for the base. The vegetation on this abandoned site consists of mostly red and black mangroves.

The site is an old landfill used for disposal of solid and generic waste from past Navy operations within the Former NASD. Waste materials extend approximately 100 feet to 120 feet north-northeast of State Route 200 from the east side of the Laguna Kiani Bridge. Trash likely disposed at this site included cans of lubricants and oil, solvents, paints, and rubble. A CH2M HILL inspection in conjunction with a UXO avoidance team (CH2M HILL, May 2000) also identified ordnance items and solid waste from the base galley (such as pieces of broken glass and china). An Initial Assessment Study (IAS) team (*Initial Assessment Study, Naval Station Roosevelt Roads, Puerto Rico, September 1984*) had estimated that this site contains approximately 800 cubic yards of material. A geophysical survey has been conducted across the area (Expanded PA/SI, CH2M HILL, November 2000) to determine the extent of buried wastes within this landfill. Buried wastes identified during this geophysical survey are outlined in figures in Section 4. No live MEC have been identified at this SWMU-6. However, inactive MEC have been identified such as inert concrete filled practice bombs, empty bomb dispensers, and empty shell casings.

2.1.2 SWMU 7 – Quebrada Disposal Site

The Quebrada Disposal Site encompasses an area of approximately 1 acre and is located west of a dirt (unpaved) access road running south from State Road 200 (Figure 2-2). The landfill site was used between the early 1960s and late 1970s. Vegetation has taken over the area, making it difficult to keep the site clear and thus limiting access to the site for investigation purposes.

The steep ravine varies from 20 to 30 feet wide, with 10 to 20-foot deep embankments. An estimated volume of 1,500 cubic yards of solid waste was discarded into the ravine by pushing it over the embankment (IAS, 1984). A visual site inspection was conducted by a UXO avoidance team, and a magnetometer survey was conducted within the sampling locations as part of the UXO avoidance survey as a safety measure prior to intrusive

sampling work at SWMU 7during the expanded PA/SI. No live OE was identified at SWMU-7 during this survey.

2.1.3 AOC H – Power Plant

The AOC H site is an abandoned concrete building approximately 80 feet long and 25 feet wide. The building housed power generation equipment for a period of 3 years prior to Navy activities (1941 to 1943). The building held power generation equipment and large diesel generators to provide electricity to a nearby community (Figure 2-3). The site is located adjacent to Highway 200, the main road into the Former NASD, and a drainage ditch located to the west of the site contains tidal water from Vieques Passage. Historically, aboveground storage tanks (ASTs) associated with the generators were reportedly located on the west side of the building and provided an estimated 2,000 to 3,000 gallons of diesel fuel storage. These tanks are no longer onsite. The building and its surrounding area included for sampling and investigation covers an area less than 0.5 acres.

After 1943, the building was vacant until the 1960s when it was used for fire training operations. The firefighter training included the use of diesel fuel, which was poured over rubber tires inside the building and ignited to simulate structure fires. The fire training activities ceased in the 1980s. The building has remained abandoned and overgrown with vines and tall shrubs. An ecological survey indicated use of the building by fruit bats as a habitat.

2.1.4 AOC J – Former Staging Area Disposal Site

The AOC J site encompasses an area of approximately 1.2 acres and was used from 1965 to 1973 as a solid waste dumpsite for construction staging activities. The site is located in a wooded area next to a tidally-influenced stream on the north coast of the Former NASD (Figure 2-4). After 1973, most of the unidentified solid waste was removed from the site and placed in a municipal landfill offbase.

In May 2000, a CH2M HILL inspection with a MEC avoidance survey team identified several scrap metal pieces associated with ordnance and explosive (OE) items (CH2M HILL, October 2000). An MEC avoidance survey was conducted prior to soil boring and groundwater well installations at this site during the PA/SI. No live OE was identified at soil or groundwater sample locations or their immediate vicinities at this site.

2.2 Regional and Site-Specific Geology

2.2.1 Regional Geology

The geology of Vieques is characterized by volcanic rocks generally overlain by alluvial deposits and patches of limestone. Volcanic andesites, deposited in a marine environment, were intruded by a quartz-diorite plutonic complex that is exposed over a large percentage of the island. A gradual change in texture from coarse to fine-grained quartz-diorite has been observed from west to east. Limestone occurs in sectors of the north, south, and eastern parts of the island. The most extensive areas of limestone are found on the south coast peninsulas. The limestone is generally soft, yellowish, and well-indurated where exposed to the atmosphere. The sedimentary deposits consist of a mixture of sand, silt, and clay. The

floodplains consist of beach and dune deposits formed by calcite, quartz, volcanic rock fragments, and minor magnetite (USGS, 1989).

The Master Work Plan for the Former NASD (CH2M HILL, January 2001) contains a detailed description of the geology of the area.

2.2.2 Site-Specific Geology and Hydrology

2.2.2.1 SWMU 6 – Mangrove Disposal Site

This site is characterized by swamp or marsh geology. The soil is highly organic with a mixture of fine to coarse silty-sand. Generally, the subsurface soil is in a loose matrix and is very permeable. At greater depth, the soil contains fine shell fragments and fine sand.

Groundwater flow determined by a one-time measurement indicated that the flow direction is to the south with relatively flat gradients in this wetland area. The likely downgradient release point for the site groundwater is the Vieques Passage, though the previously collected data did not clearly indicate this. The flow direction may also be influenced by the tidal fluctuations. Thus, the flow direction may change depending on the tidal currents and the time of day. Section 4 includes a proposal for time series water level measurements to determine tidal influence on water levels and direction of flow at this site. The water table is very shallow, 3 feet below land surface (bls) at the highest surface elevation onsite (Figure 2-5).

2.2.2.2 SWMU 7 – Quebrada Disposal Site

The geology of this site is characterized by volcanic rock overlain with sandy silt to 7 to 10 feet bls.

Localized surface water flows northwest and into the ravine. General groundwater flow is north in the direction of the Vieques Passage. On this site, depth to water is between 50 and 75 feet bls (Figure 2-6).

2.2.2.3 AOC H – Power Plant

This site is mostly silty sand down to 6 feet, where it becomes loose sand with some gravel to 20 feet bls.

The generalized groundwater flow is north-northwest in the direction of the Vieques Passage. Wells on this site run dry upon purging and are slow to recharge, making them difficult to sample (Figure 2-7). Depth to water ranges from 8 feet to 10 feet bls under this site.

2.2.2.4 AOC J – Former Staging and Disposal Site

Deep alluvial deposits consisting of silty clay, clayey sand, gravel, and rock fragments are found on this site. Highly organic soils, common in the northern portion of the site, are a result of stagnant tidewater retained by sand dunes blocking the mouth of the stream running south to north on the east site boundary. Iron oxide staining is prevalent on subsurface soils at a depth of 6 to 7 feet bls.

Groundwater flow at this site is north in the direction of the Vieques Passage. The flow of localized groundwater is almost stagnant due to a relatively flat water table. Depth to water ranges from 3 feet near the shore to 10 feet slightly upland (Figure 2-8).

2.3 Previous Investigations

2.3.1 SWMU 6 – Mangrove Disposal Site

The Expanded PA/SI Report included the details of the investigations conducted to date at this site. This section includes excerpts from this previous report.

2.3.1.1 Ecological survey

An ecological survey was conducted to describe the site flora and fauna (Geo-Marine, August 2000). The survey concluded that no endangered or threatened species were observed at this site. Federally listed species potentially occurring at the Former NASD is shown in Table 2-1.

2.3.1.2 Confirmation Study (CS)

A confirmation study was conducted to determine whether specific toxic or hazardous materials were released from Navy activities (ESE, May 1986). The sample effort collected five surface water, five sediment, and eight soil samples. These samples were analyzed for pH, chromium (total and hexavalent), lead, volatile organic compounds (VOCs), xylene, methyl ethyl ketone, and methyl isobutyl ketone. No groundwater samples were collected during the CS activities at this site.

Surface water analytical results detected lead and chromium above detection limits, but they were within ambient water quality criteria and drinking water criteria. In the soil, the concentrations of total chromium ranged from 18.5 to 48.2 mg/kg, and lead concentrations ranged from 10.2 to 345 mg/kg. In the sediment, total chromium concentrations ranged from 5.28 to 88.4 mg/kg. The concentration of lead found in the sediment ranged from 2.82 to 312 mg/kg.

2.3.1.3 Expanded PA/SI

In April and May 2000, CH2M HILL conducted an Expanded PA/SI investigation. The study included geophysical surveys, UXO avoidance, installation and sampling of four monitoring wells, and the collection of seven surface water, seven sediment, eight surface soil, and four subsurface soil samples. All samples were analyzed for metals, VOCs, semi-volatile organic compounds (SVOCs), pesticides, PCBs, and explosives. The soil, surface water, and sediment samples were collected at similar locations to those identified in the Confirmation Study (ESE, 1986).

2.3.1.3.1 Geophysical Survey

A magnetometer survey was conducted to help delineate potential areas of buried metallic waste. From the survey, most ferrous metal debris appeared to be present in the northern portion of the site and under the road of the survey area. Appendix G of Expanded PA/SI (CH2M HILL, 2000) includes details of the geophysical survey report for this site. Appendix

A of this report includes a GPS survey report and coordinates for the waste locations within the SWMU 6 landfill, conducted by NAEVA.

2.3.1.3.2 Unexploded Ordnance (UXO) Avoidance

UXO technicians did not find any active items at this site during visual site inspection or a magnetometer-aided survey at the sampling locations. Navy Explosive Ordnance Disposal (EOD) technicians examined two bomb dispensers at SWMU 6 and confirmed that they were empty and posed no hazard.

2.3.1.3.3 Laboratory Analytical Results

Groundwater analytical results from unfiltered (total metals) samples indicated detections of aluminum, antimony, arsenic, barium, cadmium, iron, lead, and manganese at concentrations exceeding the maximum contaminant levels (MCLs) and/or tap water preliminary remediation goals (PRGs). Filtered metals (dissolved) results show detections of barium, cadmium, and manganese above the MCLs and/or tap water PRGs. Since the upgradient and downgradient concentrations of these target compounds were similar, the analysis indicated that these levels are likely to be the result of background conditions and were not site related. Additional compounds detected above the PRGs included PCBs Aroclor 1221 and Aroclor 1232. The well (MW04) that contained low level PCBs was re-sampled, and PCBs were below detection limits (see Appendix F). Explosives, pesticides, SVOCs, and VOCs were either not detected, or detected at concentrations below their applicable screening criteria.

Surface soil samples contained above-criteria quantities of aluminum, antimony, arsenic, chromium, copper, iron, lead, manganese, thallium, and vanadium. SVOCs found were anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, fluoranthene, naphthalene, phenanthrene, and pyrene above the human health, leachability, and/or ecological screening criteria. The metals detected in all surface soil samples were at relatively similar concentrations, indicating they could be the result of background conditions and not site related. Explosives, pesticides, PCBs, and VOCs were either not detected, or detected at concentrations below their applicable screening criteria.

In subsurface soil samples collected, arsenic was detected above the leachability criterion though within the range of soil background levels. All VOCs, SVOCs, pesticides, PCBs, and explosives either were not detected or detected below their applicable screening criteria.

The surface water samples collected showed some levels of arsenic, copper, lead, mercury, and silver at concentrations exceeding the human health, acute ecological, and chronic ecological screening criteria. All VOCs, SVOCs, pesticides, PCBs, and explosives were either not detected or detected below their applicable screening criteria.

Sediment samples analyzed detected arsenic, chromium, lead, nickel, and zinc in a single sediment sample at concentrations exceeding the Sediment Quality Assessment Guidance (SQAG) and/or National Oceanic and Atmospheric Administration (NOAA) criteria. Copper was detected in all sediment samples below background criteria. All VOCs, SVOCs, pesticides, PCBs, and explosives were either not detected or detected below their applicable screening criteria.

2.3.1.4 Crab Study

A crab study was conducted by the Fish and Wildlife Service, DOI, in 2002 to evaluate the levels in fiddler crab and land crab tissue of pesticides and heavy metal contamination. According to the study, DDT, DDE, lead, and cadmium were detected within the sample tissue analyzed.

2.3.2 SWMU 7 – Quebrada Disposal Site

The Expanded PA/SI Report included the details of the investigations conducted to date at this site. This section includes a summary of the detailed information included in the PA/SI report.

2.3.2.1 Ecological Survey

An ecological survey was conducted in August 2000, by Geo-Marine, Inc. The survey found no vegetation stresses in the area. No federally protected species or preferred habitat were observed at SWMU 7.

2.3.2.2 Confirmation Study

A confirmation study was conducted to determine whether specific toxic or hazardous materials have contaminated the environment because of Navy activities (ESE, May 1986). Three monitoring wells were installed and samples were collected from the groundwater. Six soil samples and three sediment samples were collected and analyzed for pH, priority pollutants, oil and grease, VOCs, methyl ethyl ketone, methyl isobutyl ketone, ethylene dibromide, chromium (total and hexavalent), xylene, and lead. The study found that the metals cadmium, total chromium, and nickel exceeded drinking water and ambient water quality criteria in groundwater. No soil or sediment samples collected had elevated levels of contaminants of concern for this site. Chromium was detected at concentration of 26.3 mg/kg in the soil and 6.5 mg/kg in the sediment.

2.3.2.3 Phase I PA/SI

CH2M HILL performed field activities related to the Expanded PA/SI in April and May 2000. Two groundwater monitoring wells were installed since two of the previous wells could not be found at the locations indicated in the 1986 report. In addition, six surface soil and three sediment samples were collected near the locations specified in the 1986 report. The samples were analyzed for metals, VOCs, SVOCs, pesticides, PCBs, and explosives. Concentrations for the compounds were compared to USEPA Region IX screening criteria for each matrix.

Analytical results from unfiltered (total metals) groundwater samples detected aluminum, antimony, arsenic, iron, manganese, vanadium, and zinc in at concentrations exceeding the MCLs and/or PRGs. Filtered metals (dissolved) results detected aluminum, iron, manganese, and vanadium above MCLs and/or PRGs. Metals were detected in all wells including the upgradient well and are likely indicative of background concentrations, not site-related activities. One well (MW03) that had low-level perchlorate was re-sampled to confirm the presence of perchlorate, and perchlorate was not detected (see Appendix F).

Surface soil samples also detected above-criteria concentrations of aluminum, arsenic, chromium, copper, iron, lead, manganese, thallium, vanadium, and benzo(a)pyrene. The metals were in similar concentrations and were regarded as not site-related. Benzo(a)pyrene was detected at low concentrations slightly exceeding residential PRG. Pesticides, PCBs, and explosives were either not detected or detected below their applicable screening criteria.

Sediment samples detected several metals at concentrations exceeding the ecological screening criteria and lower than background concentrations, therefore are not likely due to site-related activities. All VOCs, SVOCs, pesticides, PCBs, and explosives were either not detected or detected below their applicable screening criteria.

A UXO avoidance survey noted a practice depth charge in the ditch.

2.3.3 AOC H – Power Plant

The Expanded PA/SI Phase II Report includes details of the previous investigations conducted at this site. This section includes a summary of the detailed information included in the PA/SI Report.

2.3.3.1 Ecological Survey

An ecological survey was conducted in August 2000, by Geo-Marine, Inc. The survey concluded that no endangered or threatened species were present at this site.

2.3.3.2 Environmental Baseline Survey

An Environmental Baseline Survey (EBS) was performed on the site (EBS, June 2000). Soil wipe samples were collected from the building's concrete floor to determine if PCBs were present. The analysis concluded PCB contamination was not present.

2.3.3.3 Expanded PA/SI

The Expanded PA/SI field investigation was performed by CH2M HILL to determine if contaminants of concern existed on this site (CH2M HILL, December 2000). Sixteen surface/subsurface soil samples were collected at the building perimeter and four surface soil samples were collected inside of the building to characterize the extent of site contamination. One upgradient and three downgradient groundwater samples were collected from site monitoring wells.

Groundwater analytical results indicated total metals exceedances above the tap water PRGs for aluminum, antimony, arsenic, barium, iron, manganese, vanadium, and thallium. Since these constituents occur naturally in the soil, their presence might have resulted from suspended particles rather than dissolved in groundwater. One exceedance of the pesticide p,p'-DDD was found. Dissolved metals, VOCs, PCBs, and explosives were either not detected or detected at concentrations below applicable screening criteria.

The analysis of surface soil samples detected aluminum, antimony, arsenic, chromium (total), iron, lead, manganese, benzo(a)pyrene, n-nitrosodi-n-propylamine, p,p-DDE, p,p-DDT, and 2,6-dinitrotoluene above the screening criteria. The concentrations of explosives were found to be below the residential and industrial PRG. All VOCs and PCBs were either not detected or detected at concentrations below applicable screening criteria.

The subsurface soil samples showed no constituent above risk-based criteria.

2.3.4 AOC J - Former Staging Area Disposal Site

The Expanded PA/SI Phase II Report includes details of the previous investigations conducted at this site. This section includes a summary of the detailed information included in the PA/SI Report.

2.3.4.1 Environmental Baseline Survey

As part of the EBS, two soil samples were collected at 3 to 4 feet bls adjacent to the visible remains of the disposal site from a backhoe excavated pit. The samples were analyzed for VOCs, SVOCs, pesticides, PCBs, and metals. Analytical results showed no elevated levels of any constituent of concern for this site.

2.3.4.2 Ecological Survey

An ecological survey was conducted in August 2000, by Geo-Marine, Inc. The survey concluded that no endangered or threatened species were present at this site.

2.3.4.3 Expanded PA/SI

A field investigation for the Expanded PA/SI was conducted by CH2M HILL (CH2M HILL, December 2000). During this study, a barbed wire fence was put up to delineate the site and keep visitors away from the site. Five surface soil, five surface water, five sediment, and four groundwater samples were collected and analyzed for metals, VOCs, SVOCs, pesticides, PCBs, and explosives. The samples were compared against USEPA Region IX screening criteria and ecological screening values for sediment (ECOSD). One monitoring well was installed upgradient and three were installed downgradient of the site. Groundwater samples were collected from each monitoring well. One upstream surface water/sediment sample was collected in the adjacent stream or quebrada and four other surface water/sediment samples were collected at equally spaced locations downstream of the site in the direction toward the ocean (Vieques Passage). A UXO avoidance study was conducted before any intrusive activities were performed since potential UXO/OE items could be found on site.

From the laboratory analysis, concentrations of aluminum, arsenic, barium, cadmium, iron, lead, manganese, and vanadium exceeded the MCLs and/or tap water PRGs. Since these metals occur naturally in the soil, the presence of these constituents may be a result of suspended particles rather than dissolved within the groundwater. Perchlorate was detected in groundwater above the tap water PRG. This well (MW01) was re-sampled, and perchlorate was not detected in the more recent sample. Pesticides, PCBs, SVOCs, and VOCs were either not detected or detected at concentrations below applicable screening criteria.

Surface water exceedances included copper and mercury. The detected concentration of copper was below background levels. Mercury values were reported at or near the method detection limit (MDL) and are likely a false positive (concluding that contamination is present when it is not, or a Type I error). Values at or near the MDL, by definition, are not accurate or precise. A practical quantitation limit (PQL) based on the reported MDL would be 0.25 μg/L. All reported mercury values were well below this calculated PQL. Explosives,

pesticides, PCBs, SVOCs, and VOCs were either not detected or detected at concentrations below applicable screening criteria.

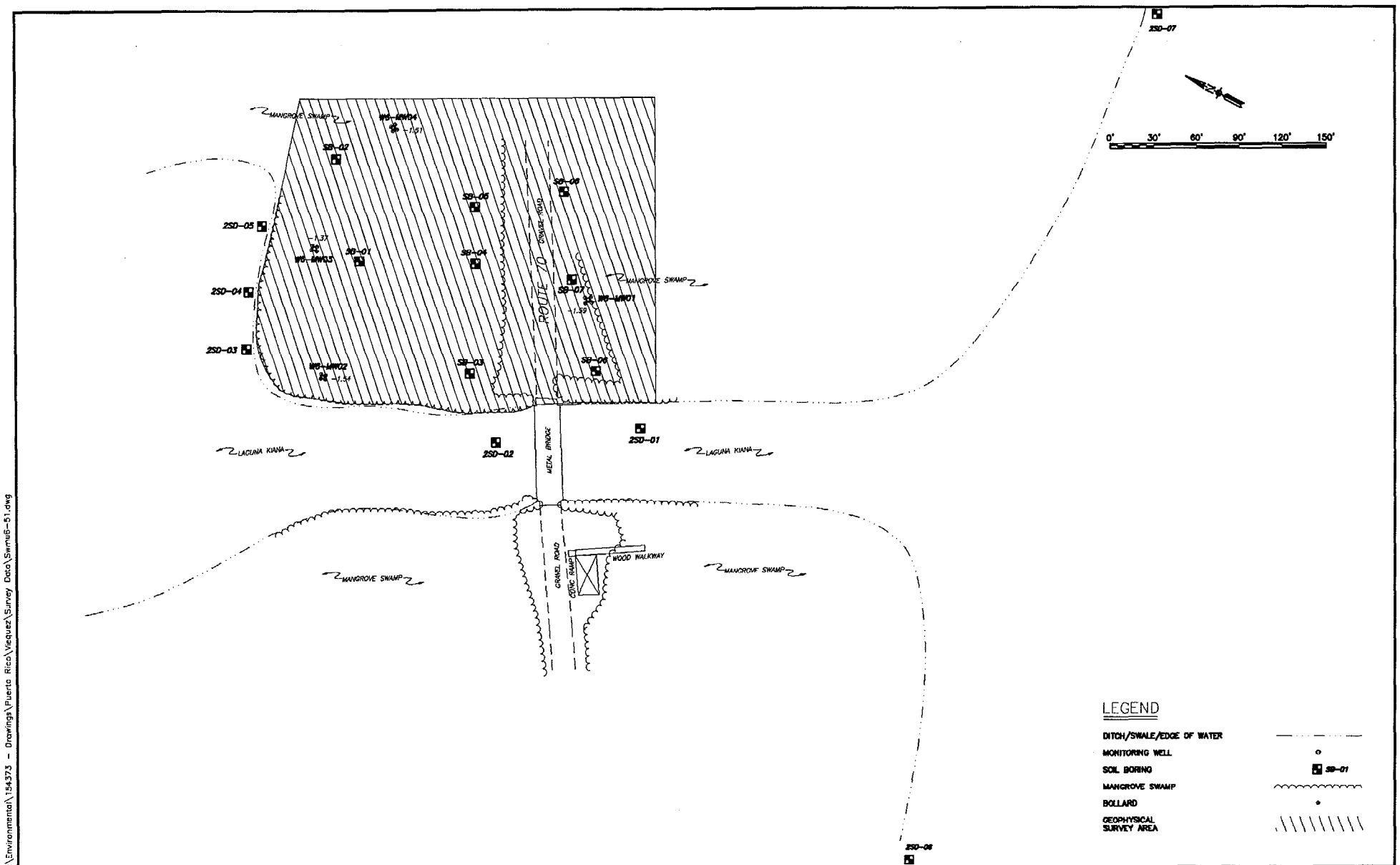
Compounds in surface soil samples that showed exceedances above residential PRGs were aluminum, arsenic, iron, manganese, and vanadium. Explosives, pesticides, PCBs, SVOCs, and VOCs were either not detected or detected at concentrations below applicable screening criteria.

Subsurface soil and sediment samples collected showed no exceedances of target compounds above screening criteria.

TABLE 2-1
Federally Listed Species Occurring or Potentially Occurring at NASD
Phase II PA/SI, Seven Sites
NASD, Vieques Island, Puerto Rico

Scientific Name (Common Name)	Federal Status
Plants	
Chaemacrista glandulosa var. mirabilis (Herb)	Endangered
Stahlia monosperma (Cobana negra)	Threatened
Calyptranthes thomasiana (Tree)	Endangered
Eugenia woodburyana (Evergreen tree)	Endangered
Goetzea elegans (Beautiful goetzea)	Endangered
Reptiles and Amphibians	
Chelonia mydas (Green sea turtle)	Threatened
Dermochelys coriacea (Leatherback sea turtle)	Endangered
Caretta caretta (Loggerhead sea turtle)	
Eretmochelys imbricata (Hawksbill sea turtle)	Endangered
Birds	
Falco peregrinus tundrius (Arctic peregrine falcon)	Threatened
Pelecanus occidentalis occidentalis (Brown pelican)	Endangered
Sterna dougalli dougalli (Roseate tern)	Endangered
Mammals	
Physeter macrocephalus (Sperm whale)	Endangered
Balaenoptera physalus (Fin whale)	Endangered
Megaptera novaeangliae (Humpback whale)	Endangered
Trichechus manatus (West Indian manatee)	Endangered

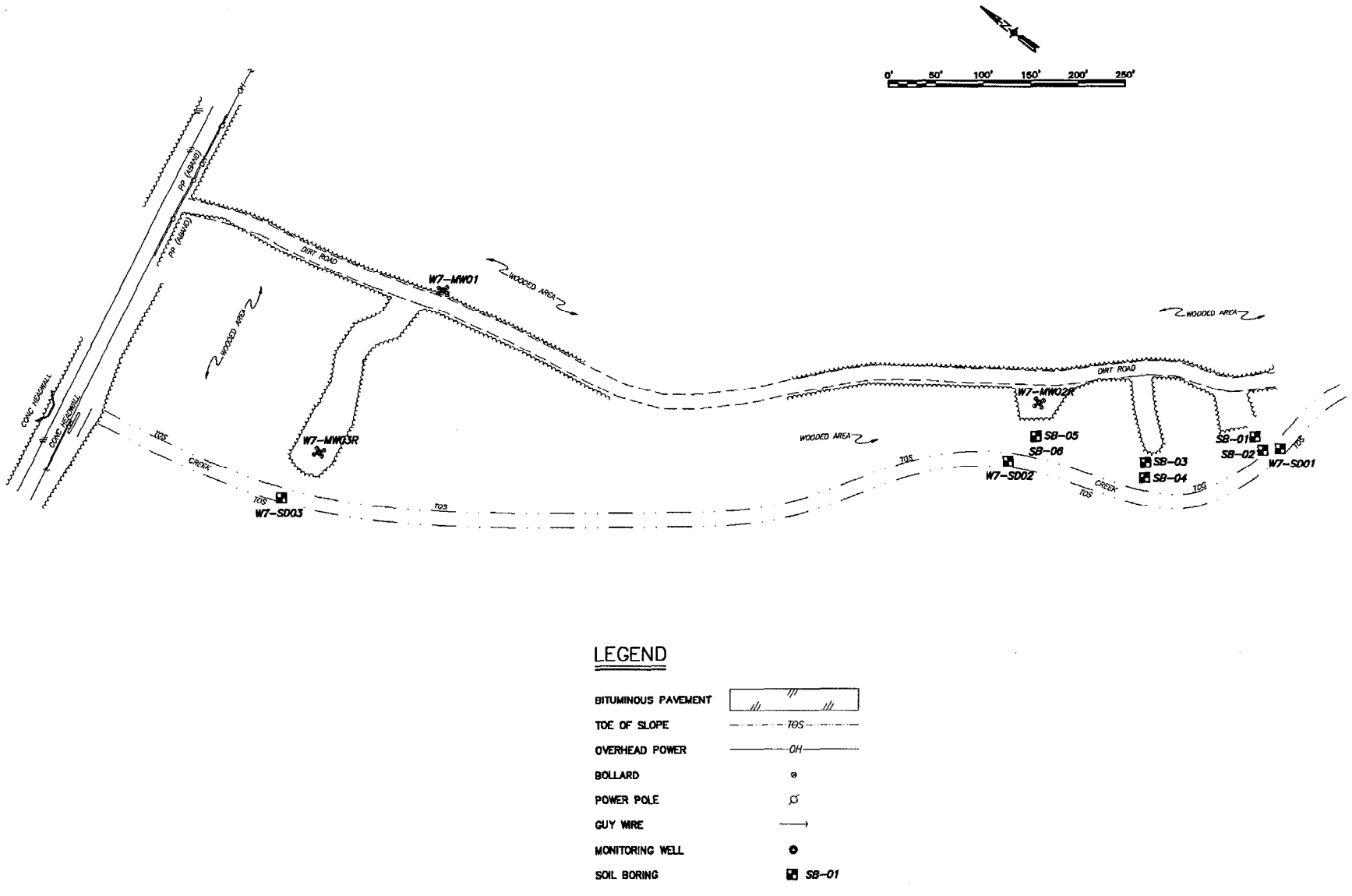
Source: Geo-Marine, Inc. 2001



P:\Environmental\154373 - Drawings\Puerto Rico\Vieques\Survey Data\Swmu6-51.dwg

Figure 2-1
SWMU 06 Site Location Map
Former NASD, Vieques Island, Puerto Rico

CH2MHILL



P:\Environmental\154373 - Drawings\Puerto Rico\Vieques\Survey Data\Swmu7-01.dwg

Figure 2-2
SWMU 07 Site Location Map
Former NASD, Vieques Island, Puerto Rico

CH2MHILL

Figure 2-3
AOC H Site Location Map
Former NASD, Vieques Island, Puerto Rico

CH2MHILL

N

300 0 300 Feet

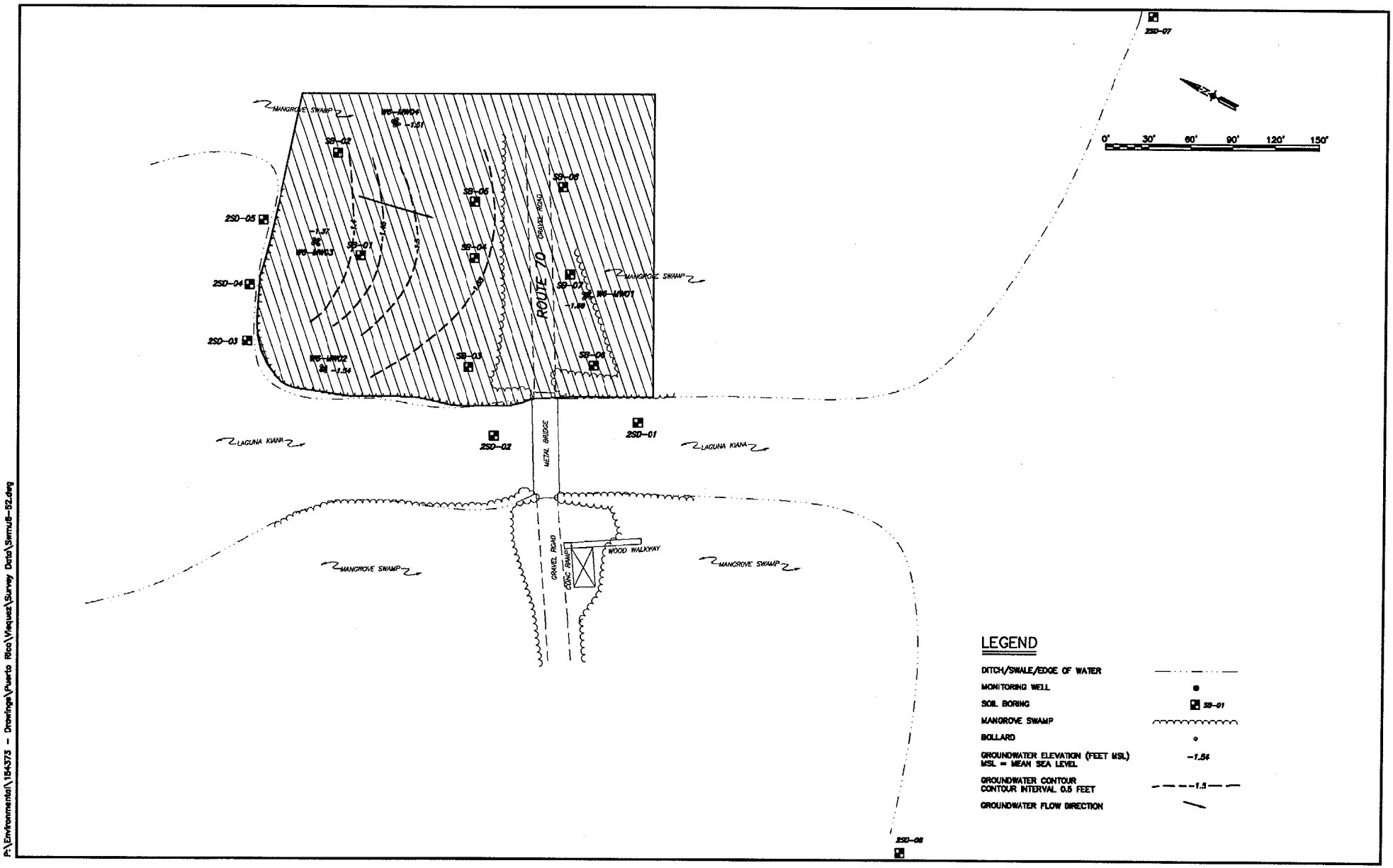
FILE REFERENCE: t:\environmental\navy clean ii_vieques_ pr\former nasd\gis\aoc j and h.apr
LAYOUT: AOC J
DATE: Aug 12, 2002 4:10 PM

02182DB24

Figure 2-4
AOC J Site Location Map
Former NASD, Vieques Island, Puerto Rico

CH2MHILL

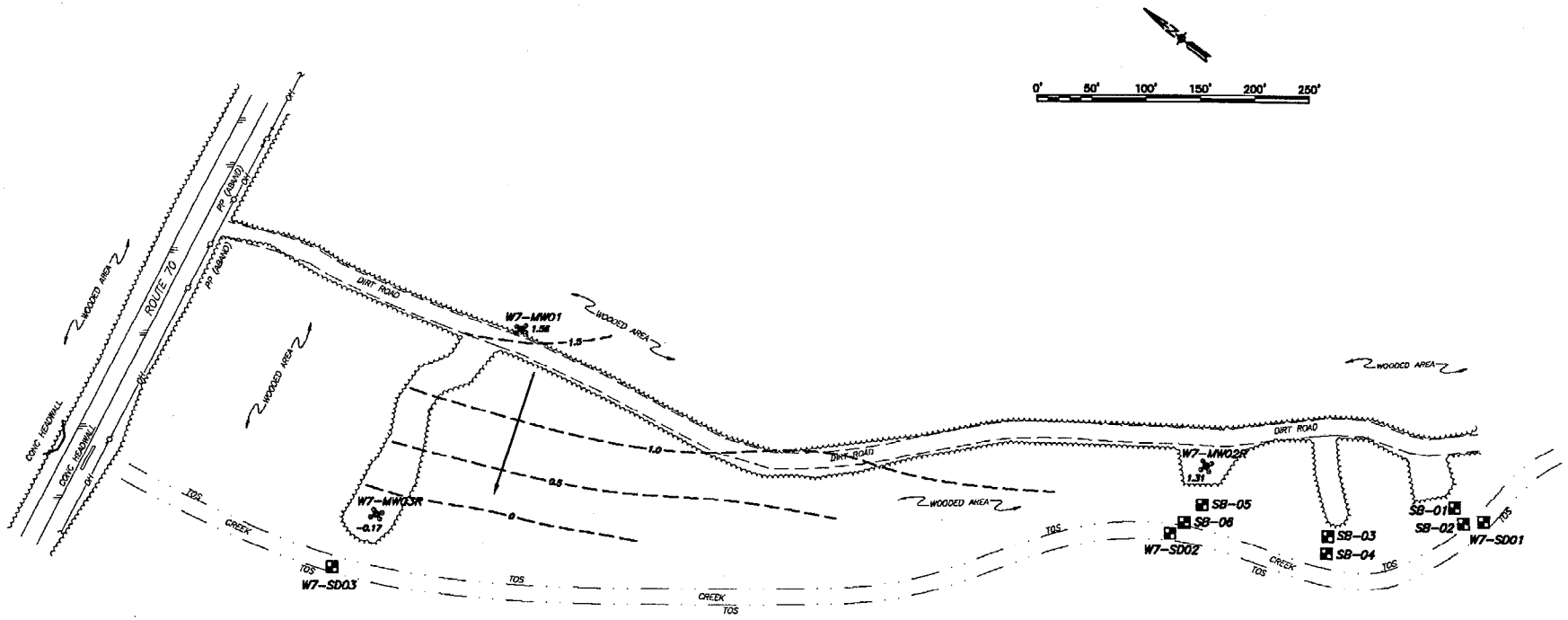
FILE REFERENCE: t:\environmental\navy clean ii_vieques_ pr\former nasd\gis\aoc j and h.apr
LAYOUT: AOC J
DATE: Aug 12, 2002 4:10 PM



P:\Environmental\154373 - Drawings\Puerto Rico\Vieques\Survey Data\Swmu6-52.dwg

Figure 2-5
SWMU 06 Groundwater Flow Map
Former NASD, Vieques Island, Puerto Rico

CH2MHILL



LEGEND

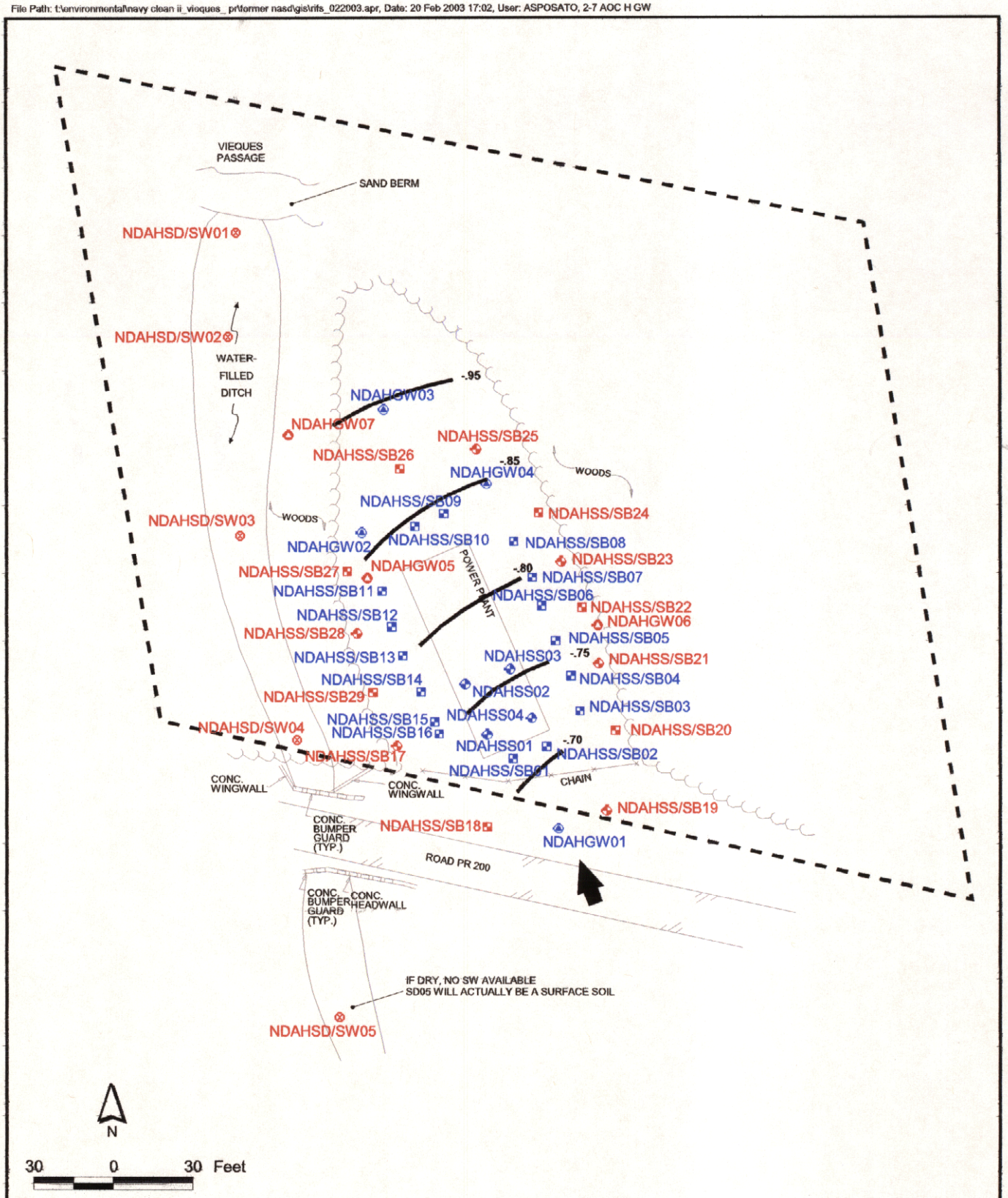
BITUMINOUS PAVEMENT	
TOE OF SLOPE	TOS
OVERHEAD POWER	OH
BOLLARD	
POWER POLE	
GUY WIRE	
MONITORING WELL	
SOIL BORING	SB-01
GROUNDWATER ELEVATION (FEET MSL) MSL = MEAN SEA LEVEL	-1.54
GROUNDWATER CONTOUR CONTOUR INTERVAL 0.5 FEET	-1.5
GROUNDWATER FLOW DIRECTION	

P:\Environmental\154373 - Drawings\Puerto Rico\Vieques\Survey Data\Swmu7-82.dwg

Figure 2-6
SWMU 07 Groundwater Flow Map
Former NASD, Vieques Island, Puerto Rico

CH2MHILL

File Path: t:\environmental\navy clean ii_vieques_pr\former nasd\gis\rifs_022003.apr, Date: 20 Feb 2003 17:02, User: ASPOSATO, 2-7 AOC H GW



LEGEND

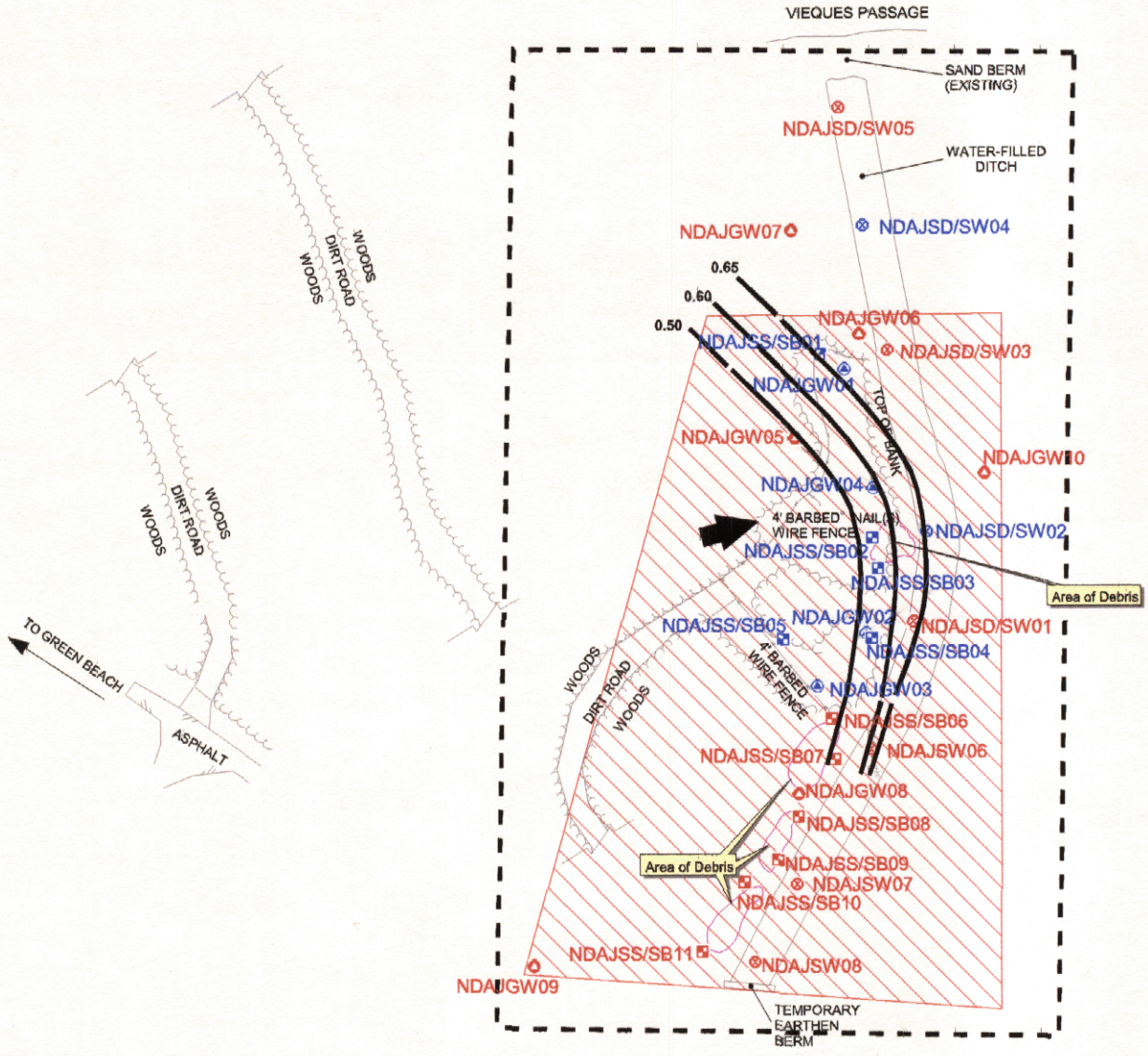
- Existing Monitoring Wells
- Proposed Monitoring Wells
- Existing Surface Soil
- Proposed Surface Soil
- Existing Surface/Subsurface Soil Borings
- Proposed Surface/Subsurface Soil Borings
- Proposed Sediment/Surface Water
- AOC/SWMU Boundary
- Groundwater Flow

Figure 2-7
AOC H Groundwater Contour Map
Former NASD, Vieques Island, Puerto Rico

CH2MHILL

02182DB34

File Path: t:\environmental\navy clean ii_vieques_ pr\former nasd\gis\rifs_022003.apr, Date: 20 Feb 2003 17:06, User: ASPOSATO, 2-8 AOC J GW



LEGEND

- Existing Monitoring Wells
- Proposed Monitoring Wells
- Existing Sediment/Surface Water
- Proposed Sediment/Surface Water
- Existing Surface/Subsurface Soil Borings
- Geophysical Survey Area
- Debris Boundaries
- AOC/SWMU Boundary
- Groundwater Flow

N

100 0 100 Feet

Figure 2-8
AOC J Groundwater Contour Map
Former NASD, Vieques Island, Puerto Rico

CH2MHILL

SECTION 3

Initial Evaluation and Conceptual Site Models

An understanding of the dynamics between the site conditions, contaminants present at the site, and potential receptors is essential to scoping the RI/FS work tasks. Based on the extensive investigation work previously conducted at each of the four sites, a conceptual site model (CSM) has been prepared. Preliminary RAOs were developed as part of this RI/FS Work Plan to assist in identifying preliminary remedial action alternatives and RI data requirements.

This section discusses the CSMs and preliminary RAOs for the sites. A generic CSM is discussed in Section 4 of this Work Plan, but this will be expanded upon during preparation of the HH&ERA. Based on the results of the baseline HH&ERA, the RAOs may be modified as necessary to be protective of human health and the environment.

3.1 Human Health and Ecological Protection Based Screening Criteria

The screening of validated analytical results against screening criteria provides for determination of the nature and extent for contamination as well as for preliminary selection of Contaminant of potential concerns (COPCs) for use in risk assessments. The screening process provides a systematic method to identify target analytes present at the site that may require detailed evaluation. The screening criteria for this investigation, by media, are as follows:

<u>Groundwater</u>

- USEPA Region IX PRGs - Tap Water Values, October, 2002 [EPA comment – use brackish water criteria]
- PREQB Water Quality Criteria, February 2002

<u>Soil</u>

- Region IX Preliminary Remedial Goals – Residential Soil Values, October 2002.
- Region IX Preliminary Remedial Goals – Industrial Soil Values, October 2002.
- Region IX Soil Screening Level, Migration to Groundwater – Dilution Attenuation Factor (DAF) 20, October 2002.
- Ecological Soil Water Criteria: *EPA Amended Guidance on Ecological Risk Assessments at Military Bases: Process Considerations, Timing of Activities, and Inclusion of Stakeholders,* Region IV Office of Technical Services, December 10, 1998.

Sediment/Surface water

- Environmental Protection Agency. November 1995. Ecological Screening Values. In: Supplemental Guidance to RAGS: Region 4 Bulletins-Ecological Risk Assessment, Bull. No. 2, Atlanta, Georgia.
- Environmental Protection Agency. January 1996. Ecotox Thresholds, ECO Update, Office of Solid Waste and Emergency Response, Intermittent Bulletin Vol. 3, No. 2, Publication 9345.0-12FSI, EPA 540/F-95-038 PB95-963324.
- Environment Canada. September 1995b. Interim Sediment Quality Guidelines, Soil and Sediment Quality Section Guidelines Division, Ecosystem Conservation Directorate, Evaluation and Interpretation Branch, Ottawa, Ontario.
- MHSPE (Ministry of Housing, Spatial Planning, and Environment). 9 May 1994. Intervention Values and Target Values - Soil Quality Standards. Directorate-General for Environmental Protection, Department of Soil Protection, The Hague, The Netherlands.
- Region IX Preliminary Remedial Goals – Residential Soil and Tap Water Values. October 2002.
- Puerto Rico Water Quality Standards (March 2003)
- NOAA ER-L values
- Environmental Protection Agency National Recommended Water Quality Criteria
- Environmental Protection Agency Chronic Marine Ambient Water Quality Standards (2002)
- Environmental Protection Agency R-4 2000
- Environmental Protection Agency Region IV Sediment Screening Values (2000).
- Efrymson et al. (1997) PRG values.
- Environmental Protection Agency National Recommended Water Quality Criteria (2002)

3.2 Conceptual Site Model

A conceptual site model (CSM) for the project was developed to convey a summary of the sources of contamination, mechanisms of contaminant release, pathways of contaminant release and transport, and ways in which humans and ecological receptors can be exposed to risk. CSMs were developed for each of the four sites being investigated.

3.2.1 SWMU 6 – Mangrove Disposal Site

As described above, the site is an old waste disposal site located within the Mangrove area. Most of the waste appears to be general trash, including empty cans of lubricants, oil, solvents, paints, and rubble. A CH2M HILL inspection in conjunction with a MEC team (May 2000) did not find live MEC. Most of the debris consisted of solid waste from the base galley such as pieces of broken glass and china. The site is located close to the Ocean on the northern end of the island. Based on visual observation, the soils were categorized as marshy and high in organic content (similar to sediments) with a mixture of fine to coarse grained silty-sands. The groundwater at the site flows to the south with flat gradients in this wetland area, and the groundwater occurs at relatively shallow depths (less than 3 feet bls).

Potential migration of landfill contents from the subsurface to groundwater is likely. Since the site is relatively flat, surface runoff is not expected to be a significant migration pathway, and any potential surface waste present may travel with rain or tidal water into the drainage ditches or into the groundwater. Thus, the media of interest for the site include soils (surface and subsurface), groundwater, sediments and surface water in the wetlands, and tidal water flow channels near the site. Thus, all of these media onsite and in downgradient locations were included for sampling, as presented in Section 4.

A geophysical survey was conducted to determine the extent of buried metal objects in the subsurface of this relatively shallow landfill area. The site has been previously sampled as part of the Confirmatory Study and the PA/SI by collecting soil, groundwater, surface water, and sediment samples. All samples were previously analyzed for a full list of parameters including metals, VOCs, SVOCs, pesticides/PCBs, and explosives. These data indicated the presence of metals in surface water and sediments, PCBs in groundwater in a single sampling round, and PAHs in soils at the site. The well containing PCBs was re-sampled, and analytical results indicated that PCBs were no detectable in this second sampling event (see Appendix F for analytical data forms). No other contaminants of concern were detected above criteria in any of the site media. Based on the available site information, a flow chart of the potential migration pathways, exposure pathways, potential human receptors, and ecological receptors was identified for the site (Figure 3-1).

An MEC Avoidance survey was conducted at this site as part of the PA/SI prior to conducting sampling. The survey indicated that no active MEC items were found, but some inactive concrete-filled practice items were identified along the northern edge of the SWMU 6 boundary near the ocean. In addition, the UXO survey found two large unidentified dispensers located just inside the fence near the southwestern corner of the site. The two dispensers were inspected by the NSRR EOD team and proved to be empty and not hazardous.

The available site source pathways, potential migration pathways, exposure points, identified receptors were considered during sampling and analysis plan development for SWMU 6. The proposed sampling and analysis plan is presented in Section 4. A comprehensive CSM description will be included in the RI report.

3.2.2 SWMU 7 – Quebrada Disposal Site

SWMU 7 is an old disposal site located on a steep depression (drainage ditch) on the hillside that slopes toward the north. The ditch is dry most of the year, except during rain events. It is the likely conduit for the rainwater coming from uphill area. Therefore, it will be referenced as a dry ditch (not a quebrada). Although the ditch is dry within the disposal area, it eventually connects to the ocean farther downstream. During past operations, the Navy noted evidence of waste disposal from the hillside into the ditch. An estimated volume of 1,500 cubic yards of material is present along the inclines of this steep ditch. Material disposed included tires, sheet metal, drums, cans, bottles, batteries, and construction rubble. No known hazardous chemical or waste disposal occurred at this site.

The potential migration pathway of importance for this site is likely the surface runoff because of the steep incline on which this site is located. Thus, sampling of site soils and downgradient runoff points will be important to characterize any past disposal and

migration of disposed material. To a relatively minor extent, migration through the soil column may be occurring. The soil OVA readings, however, did not indicate the presence of any VOCs (more mobile contaminants).

Site soils and groundwater sampled during the PA/SI screening evaluation indicated the need for further investigation. Therefore, additional soil and groundwater sampling is included as part of RI/FS investigation.

The PA/SI data indicated that surface soil at the site had low levels (slightly above criteria) of PAHs. Groundwater did not detect any contaminants of concern above criteria. One well (NDW07GW03) had a detection of perchlorate. Re-sampling of this well, however, did not indicate detectable levels of perchlorate (see Appendix F). This well will be re-sampled as part of this RI/FS sampling effort. Sediment and surface water at the northern end of the ditch were sampled as part of the PA/SI and reported to have metals that are common to the media.

An MEC avoidance survey was conducted at this site as part of the PA/SI prior to conducting sampling. The survey indicated that no active OE items were found. However, a practice depth charge was found at this site. This finding prompted the need for MEC avoidance surveys at SWMU-7.Figure 3-2 presents the CSM for the site that identifies potential migration and exposure pathways and receptors at the site. The site is not easily accessible, and thus there are currently no human receptors. The ecological survey, however, identified this area as a thriving ecological community.

3.2.3 AOC H – Power Plant

Prior to Navy ownership of this property, the site was a power plant, which has since been decommissioned leaving only a small concrete building at the site. This concrete structure was used for fire training operations, reportedly burning diesel fuel over rubber tires.

The site is located within a relatively small area (less than 0.5 acres in size) surrounding the building. The potential migration pathways for the site under current conditions are surface runoff from the site to the nearby quebrada located directly west of the site, and vertical migration to groundwater under the site. Based on the investigations conducted thus far, the surface runoff pathway is more important than the vertical migration pathways because the observed soil contaminants are not very soluble. The contaminants are not very mobile for vertical migration. However, soil-bound chemicals could run off into the surface water during rain events. Thus, the quebrada is also included for sediment and surface water sampling in this proposed RI/FS work plan.

The site surface soil, subsurface soil, and groundwater were sampled as part of the PA/SI. Results indicated the presence of pesticides, low levels of munitions residues (2,6-dinitrotoluene), and metals in surface soils. Groundwater at the site did not detect any contaminants of concern above criteria. The sediments and surface water in the drainage ditch located adjacent to the site were not sampled as part of the PA/SI.

Based on the above information, a CSM was developed for the site (see Figure 3-3). Additional sampling of the surface soil, subsurface soil, groundwater, sediments, and surface water will be conducted to address all the potential migration and exposure pathways identified for the site.

3.2.4 AOC J – Former Staging and Disposal Site

The site is an old solid waste disposal site associated with construction staging activities. The waste was reportedly removed and disposed in a municipal landfill. No known hazardous waste disposal occurred at the site. Site soil, groundwater, surface water, and sediment samples were collected as part of the PA/SI.

An MEC avoidance survey was conducted at this site as part of the PA/SI prior to conducting sampling. The survey indicated that no active OE items were found. However, 105 mm shell casings and empty ammunition boxes were found at this site. These finding prompted the need for UXO avoidance surveys at this site.

The groundwater analysis detected perchlorate and the surface water analysis showed some inorganic contaminants of concern above criteria. The well with previously reported perchlorate was re-sampled, and the latest data did not indicate the presence of perchlorate (see Appendix F for data reports).

Based on the available information on this disposal site, potential migration, exposure pathways, and human and ecological receptors were identified (Figure 3-4). Again the potential migration pathways of interest for the site are likely to be surface run off and vertical migration to subsurface. The drainage conduit is included for sampling, and subsurface soil and groundwater at the site are also included in this RI/FS work plan for further sampling to determine the nature and extent of contamination. This work plan proposes future sampling at the site based on the conceptual understanding of the migration and exposure pathways for this site. A detailed description of the site CSM will be included as part of the RI report.

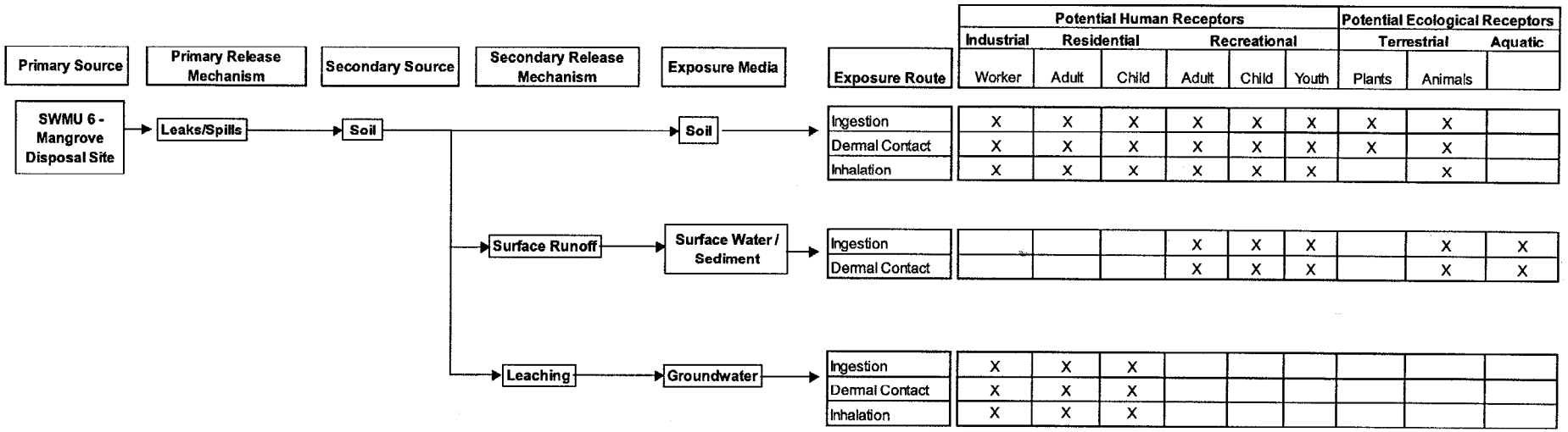
3.3 Preliminary Remedial Action Objectives and Goals

The preliminary RAOs and goals were developed to assist in identifying preliminary remedial action alternatives and RI data requirements. The preliminary RAOs are based on the existing data for the site and the CSM.

The objective of the investigation is to define the nature and extent of contamination at each of the four sites. All existing analytical data will be used to conduct a baseline risk assessment to determine the need for remedial actions to protect human health and the environment at each of the sites. If the results of the risk assessment identify a need for remedial action, the chemical and site-specific RAOs will be developed at the end of the RI/FS, prior to the Feasibility Study.

In the interim, the screening values listed in Section 3.1 may be considered preliminary RAOs. Only groundwater and surface water have federal standards (Applicable or Relevant and Appropriate Requirements [ARARs]). These include the MCLs for groundwater potable use and ambient water quality criteria (AWQCs) for surface water potable use and organism consumption. The ARARs can be found at the following web sites:

- http://www.epa.gov/safewater/mcl.html
- http://www.epa.gov/waterscience/humanhealth
- http://www.epa.gov/waterscience



Exposure Route	Potential Human Receptors: Industrial Worker	Residential Adult	Residential Child	Recreational Adult	Recreational Child	Recreational Youth	Potential Ecological Receptors: Terrestrial Plants	Terrestrial Animals	Aquatic
Ingestion	X	X	X	X	X	X	X	X	
Dermal Contact	X	X	X	X	X	X	X	X	
Inhalation	X	X	X	X	X	X		X	
Ingestion				X	X	X		X	X
Dermal Contact				X	X	X		X	X
Ingestion	X	X	X						
Dermal Contact	X	X	X						
Inhalation	X	X	X						

Notes:

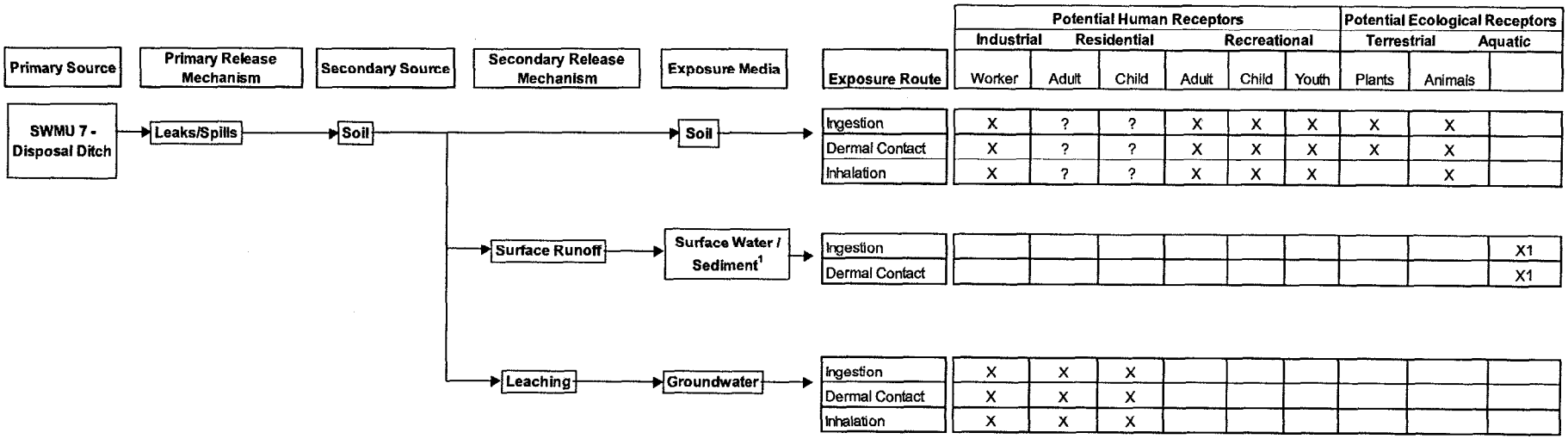
X - Potentially complete exposure pathways identified

FIGURE 3-1

Conceptual Site Model for SWMU 06: Mangrove Disposal Site

RI/FS Work Plan for the 4 Sites

NASD, Vieques Island, Puerto Rico



Notes:

X - Potentially complete exposure pathways identified

? = questionable pathway considering site is a steep sloped drianage ditch

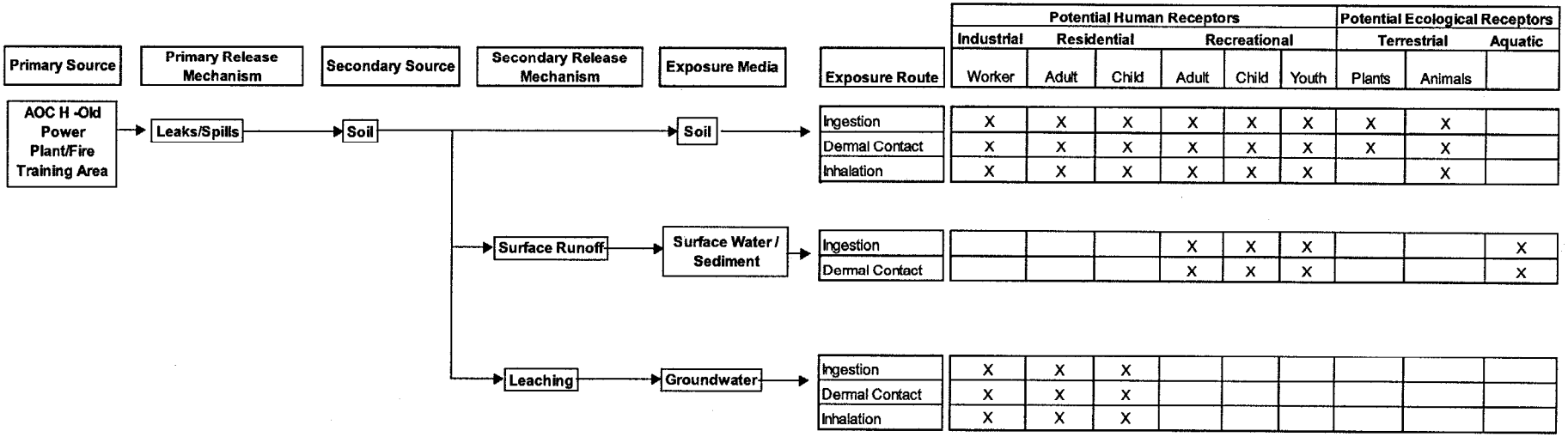
[1] = there is surface water within the site (only during very heavy rain events), samples were collected from downstream locations of this ditch

FIGURE 3-2

Conceptual Site Model for SWMU 07: Quebrada (Dry Ditch) Disposal Site

RI/FS Work Plan for the 4 Sites

NASD, Vieques Island, Puerto Rico



Notes:

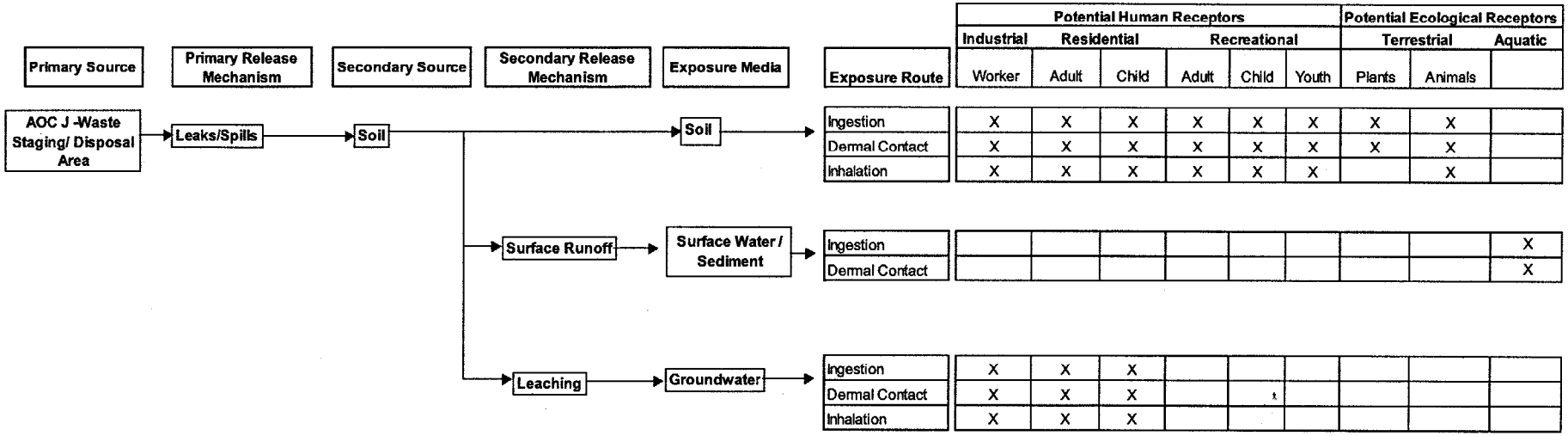
X- Potentially complete exposure pathways identified

FIGURE 3-3

Conceptual Site Model for AOC H: Old Power Plant/Fire Training Area Site

RI/FS Work Plan for the 4 Sites

NASD, Vieques Island, Puerto Rico



		Potential Human Receptors						Potential Ecological Receptors		
		Industrial	Residential		Recreational			Terrestrial		Aquatic
	Exposure Route	Worker	Adult	Child	Adult	Child	Youth	Plants	Animals	
Soil	Ingestion	X	X	X	X	X	X	X	X	
	Dermal Contact	X	X	X	X	X	X	X	X	
	Inhalation	X	X	X	X	X	X		X	
Surface Water / Sediment	Ingestion									X
	Dermal Contact									X
Groundwater	Ingestion	X	X	X						
	Dermal Contact	X	X	X						
	Inhalation	X	X	X						

Notes:

X- Potentially complete exposure pathways identified

FIGURE 3-4

Conceptual Site Model for AOC J: Waste Staging and Disposal Area Site

RI/FS Work Plan for the 4 Sites

NASD, Vieques Island, Puerto Rico

● **Proposed Surface Water/Sediment Sample Location**

FIGURE 4-3A
Location of Surface Water/Sediment Background Samples for SWMU 6
Former Naval Ammunition Support Detachment, Vieques Island

CH2MHILL

02182D04Y

SECTION 4

RI Technical Approach and Investigation Procedures

This section details the proposed sampling, technical approach, and investigation methodologies developed to perform additional remedial investigation activities for SWMU 6, SWMU 7, AOC H, and AOC J. This work plan provides the rationale and proposed locations of additional field investigations. Details regarding field sampling procedures and health and safety requirements are addressed in the facility-wide Master Work Plan for the Former NASD (CH2M HILL, January 2001). Tables 4-1 through 4-4 summarize site sampling conducted thus far, as discussed in Sections 2 and 3.

TABLE 4-1
Previously Conducted Sampling At SWMU 6 As Reported in Expanded PA/SI Report

Event/Activity	Samples	Purpose	Findings
Confirmation Study (1988)	8 Soil 5 Surface water 5 Sediment	Determine if hazardous chemicals are present	No organic contamination. Two metals were detected.
Expanded PA/SI (2000) included following investigations			
Ecological Survey	Plant and animal survey	Characterize ecology, identify threatened and endangered species, qualitative impact analysis	No threatened or endangered species identified, no impacts
Geophysical Survey	NA	Define extent of waste	3 distinct areas were identified with buried waste
UXO Avoidance Survey	NA	Determine presence of any UXO items	No live OE items were identified within SMWU 6. Inert OE items were found such as inert concrete filled practice bombs, empty bomb dispensers, and empty shell casings.
PA/SI Sampling	4 wells 8 Surface Soil 8 Subsurface soil 7 surface water 7 sediment	Determine if RI/FS is required or NFA	Metals in groundwater, surface water, and sediment were above criteria PAHs and/or metals in surface and subsurface soils were above criteria, groundwater had A single detection of PCBs were above criteria in soils and groundwater
Field Screening for VOCs	13 OVM readings (3-4 from each well boring)	Determine if soils above the groundwater had any VOCs	No VOCs were detected

TABLE 4-2
Previously Conducted Sampling At SWMU 7 As Reported in Expanded PA/SI Report

Event/Activity	Samples	Purpose	Findings
Confirmation Study (CS) (1988)	3 monitoring wells 6 Soil 3 Sediment (dry ditch soil) samples	Determine if hazardous chemicals are present. Samples analyzed for selected VOCs, priority pollutant metals and hexavalent chromium	No organic contamination. Metals were reported above criteria in groundwater samples
Expanded PA/SI (2000) included following investigations			
Ecological Survey	Plant and animal survey	Characterize ecology, identify threatened and endangered species, qualitative impact analysis	No protected species identified, no impacts from SWMU 7 reported
UXO Avoidance Survey	Visual inspection by a certified surveyor, and magnetometer survey in selected areas	Determine presence of any UXO items	No active OE were identified in the surface areas around the sampling areas A practice depth charge was the only inactive OE item found at this site
PA/SI Sampling	Re-sampling of the 3 wells from CS, 6-Surface Soil and 3 Sediment (dry ditch soils)	Determine if RI/FS is required or NFA	PAHs and inorganic chemicals in surface soil, inorganics in sediments and groundwater had metals above criteria
Field Screening for VOCs	One soil boring extended to 87 feet bls had 19 OVM reading, and second boring to 56 feet bls had 12 OVM readings	Determine if subsurface soil had more mobile VOCs	No VOCs were detected in any of the 31 readings

TABLE 4-3
Previously Conducted Sampling/Investigations At AOC H as Reported in Expanded PA/SI Phase II Report

Event/Activity	Samples	Purpose	Findings
Environmental Baseline Survey (EBS) (2000) by ERM	Wipe samples for PCBs	Determine if hazardous chemicals are present	No PCBs were detected inside the building
Ecological Survey	Plant and animal survey	Characterize ecology, identify any federally protected species are present, qualitative impact analysis	No protected species identified, no impacts from AOC H reported. Quebrada adjacent to the site has brackish water
PA/SI Sampling	4 new monitoring wells 20 Surface Soil (4 inside the building) 16 Subsurface Soil	Determine if RI/FS is required or NFA	Metals, SVOCs, and pesticides in surface soils were above criteria Groundwater had metals and a pesticide and perchlorate above criteria No chemical above criteria in subsurface soil

Notes:
Site is approximately 80 feet long x <25 feet building that was used for fire fighter training in more recent times
Site and surrounding area combined is about 0.3 to 0.5-acre size

TABLE 4-4
Previously Conducted Sampling/Investigations At AOC J as Reported in Expanded PA/SI Phase II Report

Event/Activity	Samples	Purpose	Findings
Environmental Baseline Survey (EBS) (2000) by ERM	Two subsurface soil samples from 3 to 4 feet bls, using a backhoe	To determine presence of wastes from past operations	No detections of any of the full scan analysis results above criteria
Ecological Survey	Plant and animal survey	Characterize ecology, identify any federally protected species are present, qualitative impact analysis	No protected species identified, no impacts from AOC J reported.
UXO Avoidance Survey	Magnetometer assisted surface sweep	Ensure no UXO is present at the site	No live OE was found; however, empty shell casings were found
PA/SI Sampling	4 new monitoring wells 5 surface soil 5 subsurface soil 5 surface water 5 sediment	Determine if RI/FS is required or NFA	Groundwater had metals and perchlorate above criteria Metals in surface soils and surface water were above criteria No chemicals above criteria in subsurface soils

4.1 Data Quality Objectives

Previously collected data from the two PA/SIs and any new data collected as part of this RI/FS sampling effort will be used for site characterization, risk assessment, and remedial action alternative evaluations. These data quality objectives (DQOs) require a high level of quality assurance/quality control (QA/QC). Appropriate QA/QC samples were collected during previous investigations at these sites, and the samples were analyzed at a fixed base laboratory that fulfilled the requirements of the U.S. Navy's QA/QC Program Manual and, as these sites fall under CERCLA, the USEPA's Contract Laboratory Program (CLP) and SW846 methods. Therefore, previously collected data will be used as part of the decision making process. Samples proposed as part of this RI/FS will be collected and analyzed in a similar manner so the data meets the high level DQOs.

4.2 Brush Clearance, Geophysical Survey and MEC Avoidance

An ordnance avoidance (OA) team will accompany a brush clearing team to increase the clearing size for further electromagnetic investigation such that all debris piles may be mapped at sites SWMU6, SWMU 7, and AOC J. OA will be executed as outlined in the Ordnance Avoidance Plan, presented as Appendix A. Additionally, at SWMU 6, SWMU 7 and AOC J a geophysical survey will be conducted to identify the extent of rubble and waste around the site.

4.2.1 SWMU 6

Based on the geophysical survey conducted previously, the site is approximately 1-acre in area. The waste location has been identified using a geophysical survey of the area at SWMU 6 during the PA/SI (see Appendix G of Expanded PA/SI, CH2M HILL 2000). As part of the PA/SI, an MEC avoidance survey was also conducted in the areas where soil boring and monitoring well installations were performed. During the MEC avoidance, an MEC sweep will be conducted to identify any MEC items on the surface. The boundary of

the geophysical survey area is shown in Figure 4-1 and is based on GPS data and survey data reported in Appendix G. An additional MEC avoidance survey will be conducted in the proposed area where soil boring and new well installations will be conducted. An electromagnetic (EM) survey utilizing an EM-31 instrument will be conducted to map the potential extent of buried waste along the eastern boundary of the site. Transects will be run every 25 feet to map the eastern extent of the debris. The transects will extend from the surface debris to the east until background is observed. Additionally, two background wells will be installed to the east of the SWMU 6 geophysical survey footprint area, which will also have MEC clearance prior to well installation.

4.2.2 SWMU 7

The SWMU 7 disposal site, which is approximately 1-acre in size, was also previously surveyed for MEC as part of the MEC avoidance prior to soil sample boring and monitoring well installation. No active munitions were previously identified at this site. The avoidance survey was conducted at discrete sample locations that are distributed across the site in this steep ditch and embankments of the ditch. A similar MEC avoidance survey will be conducted by certified MEC team members for any visible objects, and a thorough inspection of the sampling areas, will be conducted using magnetometers for the identification of any metal objects as part of the MEC avoidance survey. During the MEC avoidance, an MEC sweep will be conducted to identify any MEC items on the surface. An electromagnetic (EM) survey utilizing an EM-31 instrument will be conducted to map the potential extent of buried waste where waste disposal is visually identified as indicated on Figure 4-5. A 100% EM coverage using a transect of 12.5 feet will be performed on the east side of the quebrada in the area where brush has been cleared. In the steep part of the ditch where brush cannot be cleared, transects will be run across the ravine at 50-foot intervals down from the embankment into the ravine and halfway up the other side. Because the practice of waste disposal at the site was by rolling the items from the steep embankments, the waste items are visible. After the brush is cleared, the debris piles will be surveyed.

4.2.3 AOC J

A visit to AOC J subsequent to the PA/SI identified scrap metal and one empty drum outside the original area of investigation. Two additional debris piles were found approximately 77 feet and 140 feet south of NDAJMW03 and one additional debris pile was found approximately 60 feet west of NDAJMW01.

The vegetation east of the impounded water was not cleared or investigated during the PA/SI. The plan is to again exercise MEC avoidance (Appendix A) and clear brush on the eastern banks. During the MEC avoidance, an MEC sweep will be conducted to identify any MEC items on the surface.

Once the east and west sides of the impounded water are cleared of vegetation, an MEC avoidance team will accompany an EM survey team in order to map the debris piles in the disposal area utilizing an EM-31 instrument. A 100% EM coverage survey will be performed west of the ditch using a 12.5-foot transect spacing. East-west transects will be run at a spacing of approximately 50 feet beginning on the west bank of the ditch and extending approximately 100 feet east.

The mapping of the debris piles may facilitate additional surface and sub-surface soil sampling to delineate any possible further contamination. The proposed area to be surveyed is illustrated on Figure 4-7. The final extent determination will be made based on results of the site EM mapping and further action discussed with the project team.

4.3 Field Investigation

This section describes the field activities to be conducted for the RI/FS at SWMUs 6 and 7, and AOCs H and J. The RI/FS component of the program consists of the installation and sampling of additional monitoring wells to determine the extent of groundwater contamination and the collection and analysis of surface and subsurface soils, sediments, and surface waters to further define the extent of contamination in these media at the four sites. These tasks are described in the following subsections for each site.

4.3.1 SWMU 6 – Mangrove Disposal Site

The site (which is about 1-acre in size) has been investigated and extensively sampled during the PA/SI. The geophysical survey conducted during the PA/SI identified the buried wastes within this historical landfill. The avoidance survey by the MEC avoidance team found no MEC items (see Table 4-1). Additional MEC avoidance will be performed during installation of new wells and soil borings at the site.

Four monitoring wells were installed during the PA/SI at this site. Also, eight surface soil samples, eight subsurface soil samples, and seven surface water and sediment samples were collected during the PA/SI. One monitoring well (MUMW04) previously identified to contain PCBs was re-sampled, and no PCBs were detected in the groundwater sample (Appendix F).

4.3.1.1 Monitoring Well Installation

Four new monitoring wells will be added to the network of four monitoring wells that currently exist at the site. All sample locations and well elevations will be surveyed in accordance with the Civil Surveying SOP included in the Master Work Plan. The monitoring wells will be installed using the hollow stem auger method or by a hand auger to advance the well borings. In addition, continuous split spoon sampling will be conducted to document stratigraphy. MEC avoidance as outlined in Appendix A will be conducted during set-up and actual drilling operations. Groundwater at this site flows to the south, although the gradients are relatively flat. The flow direction may also be influenced by the tidal fluctuations. The tidal influence will be determined in this study, as described later in this document. The following bullets indicate rationale for selection of the well locations:

- Monitoring well NDW06MW05 will be installed approximately 100 feet south of existing well NDW06MW02 to assess contamination in the southwest part of the site.
- Monitoring well NDW06MW06 will be installed approximately 200 feet southeast of existing well NDW06MW04 to assess possible contaminants near the eastern boundary of the site.
- Monitoring well NDW06MW07 will be installed approximately 250 feet east of new monitoring well NDW6MW06 to assess site background conditions.

- Monitoring well NDW06MW08 will be installed approximately 250 feet east of well NDW06MW07 to assess site background conditions.

The depth of the well will be based on the water level measurements of the surrounding wells. The existing wells at NASD were constructed with two feet of screen above the water table. To be consistent, this design will also be used for all new wells. Estimated well depths and screened intervals are shown in Table 4-5. New wells will be constructed using 5 feet of 0.01-inch slot polyvinyl chloride (PVC) well screen coupled with 1 foot of 2-inch-diameter Schedule 40 PVC casing using flush joint threads. The proposed locations for these monitoring wells are illustrated in Figure 4-1.

TABLE 4-5
Estimated Well Depths and Screened Intervals for all Sites
Former NASD, Vieques, Puerto Rico

	SWMU 6	SWMU 7		AOC H	AOC J
Number of wells	4	5	1	3	5
Well Depth (ft)	13	75	100	20	12
Screened Interval (ft)	10	10	10	10	10

4.3.1.2 Groundwater Sampling and Analysis

The four newly installed monitoring wells and four previously existing wells will be sampled for VOCs, SVOCs, pesticides, PCBs, explosives (including perchlorate), anion, alkalinity total and dissolved metals to further evaluate these constituents detected during the previous sampling events (PA/SI). Unfiltered metals samples will be used for risk assessment whereas the filtered metals samples will be used for comparison purposes. Anion and alkalinity data will be used to characterize the water quality. Groundwater at some of these sites is within the surface water. Thus, the data will be used to estimate the groundwater hardness which is then used to estimate and select the ecological screening values for surface water.

Groundwater sampling will be conducted in accordance with the techniques described in the Master Work Plans. A round of water level measurements will first be taken from all of the wells. Afterwards, the wells will be purged and sampled using low-flow sampling techniques to minimize turbidity of the samples. Table 4-6 presents the number of groundwater samples to be collected as part of this evaluation, including QA/QC samples. Section 2 of the Master Field Sampling Plan for the former NASD (CH2M HILL, January 2001) presents details regarding the required containers, preservatives, and holding times for groundwater and soil samples. Time series water level sampling will be conducted as well as a hydraulic tidal influence study. Figure 4-1 presents the proposed well locations.

TABLE 4-6
Groundwater Sample Parameters, Methods, and Quantities for SWMU 6
Former NASD, Vieques, Puerto Rico

Parameter	Method	No. of Samples	Equipment Blanks	Field Blanks	Field Duplicates	Matrix Spike/ Duplicate	Total Number of Samples
Pesticides	LL-OLCO2.1	8	1	1	1	2	13
PCBs	LL-OLCO2.1	8	1	1	1	2	13
Total Metals	ILM04.0	8	1	1	1	2	13
Dissolved Metals	ILM04.0	8	1	1	1	2	13
VOCs	LL-OLCO3.2	8	1	1	1	2	13
SVOCs	LL-OLCO2.1	8	1	1	1	2	13
Explosives	SW846 8330	8	1	1	1	2	13
Perchlorate	EPA 314.0	8	1	1	1	2	13
IC Anions	EPA 300.0	8	1	1	1	2	13
Alkalinity	EPA 310.1	8	1	1	1	--	11

Notes:
Alkalinity will be reported as mg/L bicarbonate, carbonate, and/or hydroxide
Ion Chromatography anions include sulfate, chloride, nitrate, nitrite, and orthophosphate
Equipment blanks – one per day
Field Blanks – one per lot of ERB source water
Field Duplicates – one per every ten samples per matrix/medium or per batch, whichever is most frequent
Matrix Spike/Matrix Spike Duplicates – One per 20 samples per matrix or batch, whichever most frequent
Two wells (MW08 and 09) will be used as background data points for the SWMU 6

As previously discussed, VOCs have been eliminated from the analyte list based on data from the sampling and analysis phase of the PA/SI. Parameters to be measured and logged in the field include temperature, pH, dissolved oxygen (DO), redox potential, conductivity, salinity, and turbidity.

4.3.1.3 Soil Sampling and Analysis

Additional surface soil and subsurface soil samples will be collected to define the horizontal extent of soil contamination previously identified in the in the source area. Figure 4-2 presents the soil sampling locations proposed for SWMU 6. The following sampling rationale is proposed.

Four soil borings will be completed to the north, southeast and west of monitoring well MW04 in an attempt to identify presence and levels of PCBs in soils in this are. Historical data indicated low-level PCBs in groundwater, the presence of which could not be confirmed upon re-sampling (see Appendix F). Surface soils (0 to 6 inches) and subsurface soil samples (directly above the water table) will be collected for analysis. This results in a total of 8 soil samples.

Five soil borings will be completed along the northeastern boundary of the landfill beyond the previous geophysical survey area to further characterize the extent of fill material and soil contamination to the northeast. One soil boring will be completed between existing boring NDW06SB02 and existing well NDW06MW02. Four soil borings will be completed within the vicinity of the previously defined southeastern boundary. One soil boring will be

installed in the northwest corner of the SWMU-6 boundary as requested by EPA. Surface soil and subsurface soil samples will be collected for analysis. A total of 15 locations will be sampled for a total of 30 samples.

Surface soil samples will be collected from 0 to 6 inches (0.5 foot) bls, and subsurface soil will be collected from 1 foot bls to just above the shallow water table (<3 foot bls). These proposed sample depths are consistent with the depths of previously collected sample. Sampling techniques that may be employed for surface soil sampling include stainless-steel trowel sampling and stainless-steel hand auger sampling, depending on the nature of the material to be sampled. A stainless-steel trowel will typically be used to collect samples of loosely packed materials and a stainless-steel hand auger for densely packed materials. These procedures for soil collection and transfer of soil to sample jars are described in the standard operating procedure (SOP) for shallow soil sampling is presented as Attachment 2, Section 4.4.1 of the Master Work Plan for the Former NASD (CH2M HILL, January 2001).

Table 4-7 provides a listing of soil sample parameters and methods and includes the number of soil samples to be collected as part of this evaluation, including QA/QC samples. Details regarding the required containers, preservatives, and holding times for groundwater and soil samples are presented in Section 2 of the Master Field Sampling Plan for the Former NASD (CH2M HILL, January 2001).

TABLE 4-7
Soil Sample Parameters, Methods, and Quantities for SWMU 6
Former NASD, Vieques, Puerto Rico

Parameter	Method	No. of Samples	Equipment Blanks	Field Blanks	Field Duplicates	Matrix Spike/ Duplicate	Total Number of Samples
Pesticides	OLM04.2	30	2	1	2	4	39
PCBs	OLM04.2	30	2	1	2	4	39
SVOCs	OLM04.2	30	2	1	2	4	39
Metals	ILM04.0	30	2	1	2	4	39
Explosives	8330	30	2	1	2	4	39
Perchlorate	314.0	30	2	1	2	4	39
VOCs	OLM04.2	30	2	1	2	4	39

Notes:
Equipment blanks – one per matrix per day; blank for filtered samples is a filtration blank
Field Blanks – one per lot of ERB source water
Field Duplicates – one per every ten samples per matrix/medium or per batch, whichever is most frequent
Matrix Spike/Matrix Spike Duplicates – One per 20 samples per matrix or batch, whichever most frequent

4.3.1.4 Surface Water Sampling and Analysis

Five of the seven surface water sampling points utilized for the PA/SI (NDW06SW02, NDW06SW03, NDW06SW05, NDW06SW06, and NDW06SW07) will again be sampled for the RI/FS. Additionally, two new surface water samples will be collected (NDW06SW08 and NDW06SW09) from approximately 100 feet north and 80 feet east of well NADW06MW04. Also, two background surface water samples (NDW06SW10 and NDW06SW11) will be collected from Laguna Arenas.

These five existing, two background, and two new surface water samples will be analyzed for total and dissolved metals, the major anions, explosives, perchlorate, SVOCs, VOCs,

pesticides, and PCBs. Measurement of the major anions and alkalinity data will be used to estimate hardness. Hardness will then be used to estimate and select the ecological screening values for surface water. Figure 4-3 illustrates the proposed location of the surface water samples. Two background surface water samples will also be collected from adjacent Laguna Arenas (figure 4-3a), near previous background surface water sampling locations. One set of samples will be field filtered and preserved in order to ascertain the contribution of the dissolved constituents. Surface water sampling will be conducted in accordance with the techniques described in the Master Work Plans.

Surface water samples will be collected at mid-depth Surface water samples will be collected into a pre-cleaned 2-liter glass jar provided by the laboratory or with a kemmemer depending on the water depth. One liter of the sample will be transferred to the total metals container and the other 1-liter will be field-filtered and preserved for dissolved metals. A second aliquot will be collected for the major anions analyses and split into dissolved and total fractions as described above for metals. Table 4-8 presents the number of surface water samples to be collected as part of this evaluation, including QA/QC samples. Section 2 of the Master Field Sampling Plan for the former NASD (CH2M HILL, January 2001) presents details regarding the required containers, preservatives, and holding times for surface water samples.

Parameters to be measured and logged in the field include temperature, pH, DO, redox potential, conductivity, salinity, and turbidity. Because surface water levels and flow are tidally influenced around SWMU 6, a background sample point cannot be distinctly identified within the surrounding area. Therefore, two additional surface water samples will be collected from nearby Laguna located directly west of SWMU 6. Two surface water and sediment samples were previously collected from this water body, and were included in the background sampling report. Two new co-located surface water and sediment samples will be collected during this RI/FS sampling effort (NDW06SW06/SD06 and ND206SW07/SD07). The location of these two sampling points are presented on Figure 4-3.

4.3.1.5 Sediment Sampling and Analysis

Seven sediment samples were collected as part of the PA/SI. Twelve sediment samples are proposed to define the horizontal extent of potential runoff from SWMU 6 into sediments in the surrounding surface water bodies (see Figure 4-4). Six of these samples will be collected south of SWMU 6, three west of SWMU 6, and 3 north of SWMU-6 as agreed to by EQB at the January 16th CTC meeting. Four of these sample locations (NDW06SD02, SD03, SD05, SD06, and SD07) are from the same locations as the set of the PA/SI samples. Also, two background sediment samples (NDW06SD15 and NDW06SD16) co-located with surface water samples will be collected from the adjacent Laguna Arenas (shown in Figure 4-3a).

TABLE 4-8
Surface Water Sample Parameters, Methods, and Quantities for SWMU 6
Former NASD, Vieques, Puerto Rico

Parameter	Method	No. of Samples*	Equipment Blanks	Field Blanks	Field Duplicates	Matrix Spike/ Duplicate	Total Number of Samples
Explosives	SW846 8330	9	1	1	1	2	14
Perchlorate	EPA 314.0	9	1	1	1	2	14
SVOCs	OLMO4.2	9	1	1	1	2	14
VOCs	LL-OLCO3.2	9	1	1	1	2	14
Pesticides	LL-OLCO3.2	9	1	1	1	2	14
PCBs	LL-OLCO3.2	9	1	1	1	2	14
IC Anions	EPA 300.0	9	1	1	1	2	14
Dissolved IC Anions	EPA 300.0	9	1	1	1	--	12
Alkalinity	EPA 310.1	9	1	1	1	--	12
Dissolved Alkalinity	EPA 310.1	9	1	1	1	--	12
Total Metals	ILM04.0	9	1	1	1	2	14
Dissolved Metals	ILM04.0	9	1	1	1	2	14

Notes:
Alkalinity will be reported as mg/L bicarbonate, carbonate, and/or hydroxide
Ion Chromatography anions include sulfate, chloride, nitrate, nitrite, and orthophosphate
Equipment blanks – one per matrix per day; blank for filtered samples is a filtration blank
Field Blanks – one per lot of ERB source water
Field Duplicates – one per every ten samples per matrix/medium or per batch, whichever is most frequent
Matrix Spike/Matrix Spike Duplicates – One per 20 samples per matrix or batch, whichever most frequent
* - Two surface water samples will be collected from adjacent Laguna to the west for background samples

Sediment samples will be collected at a depth of 0 to 6 inches from a boat utilizing a hand auger or ponar. A new sediment sample (NDW06SD14) will be collected 240 feet north-northwest from the bridge and 80 feet from point of the northeastern shoreline. New sediment samples NDW06SD13 and NDW06SD12 will be located on a line parallel to the bridge and equidistant from the bridge with PA/SI sediment NDW06SD02, which will also be sampled. New sediment samples NDW06SD13 and NDW06SD12 are located 20 feet east-northeast and 45 feet west-southwest of PA/SI sediment NDW06SD02, respectively. Two other new sediment samples, NDW06SD11 and NDW06SD10 are located on the south side of the bridge on the same perpendicular line bisecting the bridge with sediment samples NDW06SD13 and NDW06SD02, respectively. The sediment samples, NDW06SD11 and NDW06SD10, are 25 feet south of the bridge on the same perpendicular lines as the previously mentioned samples north of the bridge. Sediment sample NDW06SD09 is southeast of the bridge approximately 300 feet and 40 feet from the curve of the eastern shoreline. Sediment sample NDW06SD08 is 150 feet east of sediment sample NDW06SD09 and also 40 feet from the northeastern shoreline. Figure 4-4 presents the proposed sediment sampling locations. Two background sediment samples will be collected from the Laguna

located directly west and slightly north of the SWMU 6 area. Co-located surface water samples will also be collected from these locations.

The applicable SOP for the collection of sediment samples is presented as Attachment 2, Section 4.4.1 of the Master Work Plan for the Former NASD (CH2M HILL, January 2001).

Table 4-9 provides a listing of sediment sample parameters and methods and includes the number of soil samples to be collected as part of this evaluation, including QA/QC samples. Details regarding the required containers, preservatives, and holding times for groundwater and soil samples are presented in Section 2 of the Master Field Sampling Plan for the Former NASD (CH2M HILL, January 2001).

TABLE 4-9
Sediment Sample Parameters, Methods, and Quantities for SWMU 6
Former NASD, Vieques, Puerto Rico

Parameter	Method	No. of Samples	Equipment Blanks	Field Blanks	Field Duplicates	Matrix Spike/ Duplicate	Total Number of Samples
Explosives	SW846 8330	14	1	1	1	2	19
Perchlorate	EPA 314.0	14	1	1	1	2	19
Pesticides	OLMO4.2	14	1	1	1	2	19
VOCs	OLMO4.2	14	1	1	1	2	19
SVOCs	OLMO4.2	14	1	1	1	2	19
PCBs	OLMO4.2	14	1	1	1	2	19
Metals	ILM04.0	14	1	1	1	2	19

Notes:
Equipment blanks – one per matrix per day; blank for filtered samples is a filtration blank
Field Blanks – one per matrix per day
Field Duplicates – one per every ten samples per matrix/medium
Matrix Spike/Matrix Spike Duplicates – One per 20 samples per matrix

4.3.1.5.1 Hydraulic Tidal Study

Water level measurements will be collected from the monitoring wells MW-2, MW-4, and MW-1 which were installed as part of the SWMU 6 RI/FS to provide a broader perspective of groundwater flow. The water levels will be obtained by measuring the depth to water from a marked location on the top of casing which has been surveyed to the nearest 0.01 feet msl. Time series water level sampling utilizing a data logger will be performed along with a hydraulic tidal influence study in order to ascertain potential tidal effects on groundwater levels. Tidal fluctuations will be measured by installing two stilling wells in Laguna Kiani, one at each of the two major water bodies of the lagoon to the north and south of SWMU 6. This will ensure water level stage is captured for the full tidal reach in the lagoon. The stilling wells will be installed just north of the site along the mangrove edge and on the south side along the northern mangrove edge in the major lagoon. Final determination of site suitability of mounting the stilling wells will be based on field review of the proposed locations. Continuous water level recorders will be installed in the three monitoring wells mentioned above and the two stilling wells. Water levels will be captured at approximately 10-minute intervals for a minimum of 72 hours to capture several tidal cycles in the lagoon.

Water level fluctuations in the stilling well and monitoring wells will be compared graphically to determine if groundwater levels are tidally influenced. If there is a body of surface water next to the site, a staff gauge will be installed and its level recorded along with the wells.

4.3.2 SWMU 7 – Quebrada Disposal Site

The waste at this site was pushed over the edge of very steep ravine. The waste is scattered along the slope and in the bottom of the ravine. An electromagnetic surface geophysical survey is proposed to map any potential waste at this site using an EM-31 instrument. Transects will be run across the ravine to map potential buried waste.

4.3.2.1 Monitoring Well Installation

- Five new monitoring wells will be added to the three monitoring wells that currently exist at the site. All sample locations and well elevations will be surveyed in accordance with the Civil Surveying SOP included in the Master Work Plan. Monitoring wells will be installed using the hollow stem auger method or air rotary to advance the well borings. In addition, split spoon sampling will be conducted to document stratigraphy. MEC avoidance as outlined in Appendix A will be practiced during set-up and actual drilling operations. The rationale for the well location selection is as follows:

- New monitoring well NDW07MW04 will be installed approximately 50 feet north of the waste area boundary to provide a monitoring well directly downgradient of the waste area of SWMU 7.

- New monitoring well NDW07MW05 will be located approximately 300 feet west by northwest of the new monitoring well NDW07MW04 to provide a monitoring well downgradient to well NDW07MW04.

- Monitoring well NDW07MW06 will be installed along the main road, approximately 200 feet west of the drainage ditch, to provide a downgradient well approximately 1,100 feet downgradient from the waste area.

- Monitoring well (NDW07MW07) will also be placed along the main road approximately 1,100 feet downgradient from the waste area, 300 feet west of NDW07MW06 to assess the downgradient width of the groundwater quality impacts.

- Monitoring well (NDW07MW08) will be installed approximately 100 feet to the southeast of the site to provide an upgradient (background) well to assess if the metal concentrations detected in the groundwater are associated with the site or are attributed to background conditions.

These wells are being installed in order to determine the extent of contaminant migration. The depth of these wells will be based on the water level measurements of the surrounding wells. The existing wells at NASD were constructed with two feet of screen above the water table. To be consistent, this design will also be used for all new wells. Estimated well depths and screened intervals are shown in Table 4-5. The new wells will be constructed using 10 feet of 0.01-inch slot polyvinyl chloride (PVC) well screen coupled with 20 feet of 2-inch-diameter Schedule 40 PVC casing using flush joint threads. The proposed locations for these monitoring wells are illustrated in Figure 4-5.

4.3.2.2 Groundwater Sampling and Analysis

The five newly installed monitoring wells and three existing wells will be sampled for total and dissolved metals, explosives, pesticides, and perchlorate to further evaluate these constituents detected during the previous sampling event (PA/SI). Unfiltered metals samples will be used for risk assessment whereas the filtered metals samples will be used for comparison purposes.

A round of water level measurements will be taken from all of the wells prior to sampling. If there is a surface water body next to the site, a staff gauge will be installed and its level will be recorded along with the wells. Afterwards, the wells will be purged and sampled using low-flow sampling techniques to minimize turbidity of the samples. All samples will be collected using a bladder pump as described in section 4.3.1.2. Table 4-10 presents the numbers of groundwater samples to be collected as part of this evaluation, including QA/QC samples. Figure 4-5 illustrates the proposed location of groundwater samples to be collected. Section 2 of the Master Field Sampling Plan for the former NASD (CH2M HILL, January 2001) presents details regarding the required containers, preservatives, sampling, and holding times for groundwater and soil samples.

TABLE 4-10
Groundwater Sample Parameters, Methods, and Quantities for SWMU 7
Former NASD, Vieques, Puerto Rico

Parameter	Method	No. of Samples	Equipment Blanks	Field Blanks	Field Duplicates	Matrix Spike/ Duplicate	Total Number of Samples
Metals	ILM04.0	8	1	1	1	2	13
Dissolved Metals	ILM04.0	8	1	1	1	2	13
Pesticides	LL-OLCO2.1	8	1	1	1	2	13
Explosives	SW846 8330	8	1	1	1	2	13
Perchlorate	EPA 314.0	8	1	1	1	2	13

Notes:
Equipment blanks – one per day
Field Blanks – one per lot of ERB source water
Field Duplicates – one per every ten samples per matrix/medium or per batch, whichever is most frequent
Matrix Spike/Matrix Spike Duplicates – One per 20 samples per matrix or batch, whichever most frequent

As previously discussed, VOCs, SVOCs, and PCBs have been eliminated from the groundwater analyte list based on data from the sampling and analysis phase of the PA/SI, because they were either below screening criteria or not detected. Parameters to be measured and logged in the field include temperature, pH, DO, redox potential, conductivity, and turbidity.

4.3.2.3 Surface and Subsurface Soil Sampling and Analysis

Four surface soil samples (NDW07SS18, NDW07SS19, NDW07SS20, NDW07SS21) will be collected along the drainage ditch that extends downgradient from the site to north of the Highway 200 to assess potential impacts on the ditch from stormwater runoff. These represent the ditch bottom lining soils. The locations of the surface soil samples is shown on Figure 4-5.

Six soil samples were previously collected within the visible rubble/waste area (NDW07SS/SB01 to NDW07SS/SB06). Eleven additional new soil borings will be completed, and surface and subsurface soil samples will be collected from these new boring locations. The new Station Ids are NDW07SS/SB07 through NDW07SS/SB17. This effort will result in a total of 26 new soil (15 surface and 11 subsurface) samples and additional QA/QC samples from SWMU 07. Additionally, analysis will also include metals, explosives, perchlorate, VOCs and SVOCs, in the same twenty-six samples. Surface soil samples and subsurface soil samples are proposed to be collected from each of these eleven borings to define the horizontal and vertical extent of soil contamination in the potential source area. Figure 4-5 presents the proposed locations of surface and sub-surface soil samples for collection.

Sampling techniques that may be employed for surface soil sampling include stainless-steel trowel sampling and stainless-steel hand auger sampling, depending on the nature of the material to be sampled. A stainless-steel trowel will typically be used to collect samples of loosely packed materials (surface soils) and a stainless steel hand auger for densely packed materials (subsurface soils). Surface soils will be collected at depths from surface to 6 inches. Subsurface soils will be collected at a depth of 4 feet to 6 feet or whenever bedrock is contacted, whichever comes first. These procedures for soil collection and transfer of soil to sample jars are described in the SOP for shallow soil sampling (Section 4.2, and Attachment 2 of the Master Work Plan). These procedures for soil collection and transfer of soil to sample jars are described in the SOP for shallow soil sampling, presented as Attachment 2, Section 4.4.1 of the Master Work Plan for the Former NASD (CH2M HILL, January 2001).

Table 4-11 provides a listing of soil sample parameters and methods and includes the number of soil samples to be collected as part of this evaluation, including QA/QC samples. Details regarding the required containers, preservatives, and holding times for groundwater and soil samples are presented in Section 2 of the Master Field Sampling Plan for the Former NASD (CH2M HILL, January 2001).

TABLE 4-11
Soil Sample Parameters, Methods, and Quantities for SWMU 7
Former NASD, Vieques, Puerto Rico

Parameter	Method	No. of Samples	Equipment Blanks	Field Blanks	Field Duplicates	Matrix Spike/ Duplicate	Total Number of Samples
Metals	ILM04.0	26	2	1	1	2	32
Pesticides	OLMO4.2	26	2	1	1	2	32
Explosives	SW846 8330	26	2	1	1	2	32
Perchlorate	EPA 314.0	26	2	1	1	2	32
VOCs	OLM04.2	26	2	1	1	2	32
SVOCs	OLM04.2	26	2	1	1	2	32

Notes:
Equipment blanks – one per matrix per day; blank for filtered samples is a filtration blank
Field Blanks – one per lot of ERB source water
Field Duplicates – one per every ten samples per matrix/medium or per batch, whichever is most frequent
Matrix Spike/Matrix Spike Duplicates – One per 20 samples per matrix or batch, whichever most frequent

4.3.2.4 Sediment Samples

Two sediment samples will be collected in the quebrada that runs along SWMU 7 near the beach, if standing water is present. If no water is present, they will be collected as surface soil samples. Samples will be analyzed for metals, pesticides, PCBs, explosives, and perchlorate.

TABLE 4-12
Sediment Sample Parameters, Methods, and Quantities for SWMU 7
Former NASD, Vieques, Puerto Rico

Parameter	Method	No. of Samples	Equipment Blanks	Field Blanks	Field Duplicates	Matrix Spike/ Duplicate	Total Number of Samples
Metals	ILM04.0	2	1	1	1	1	6
Pesticides	OLM04.2	2	1	1	1	1	6
PCBs	OLMO4.2	2	1	1	1	1	6
Explosives	SW846 8330	2	1	1	1	1	6
Perchlorate	EPA 314.0	2	1	1	1	1	6

Notes:
Equipment blanks – one per matrix per day; blank for filtered samples is a filtration blank
Field Blanks – one per lot of ERB source water
Field Duplicates – one per every ten samples per matrix/medium or per batch, whichever is most frequent
Matrix Spike/Matrix Spike Duplicates – One per 20 samples per matrix or batch, whichever most frequent

4.3.3 AOC H – Former Power Plant (Fire Training Area)

4.3.3.1 Monitoring Well Installation

Three new monitoring wells will be added to the network of four monitoring wells that currently exist at the site. All sample locations and well elevations will be surveyed in accordance with the Civil Surveying SOP included in the Master Work Plan. Monitoring wells will be installed using the hollow stem auger method to advance the well borings. In addition, continuous split spoon sampling will be conducted to document stratigraphy. The proposed location for these monitoring wells are illustrated in Figure 4-6. The rationale for these wells is as follows:

Monitoring well NDAHMW05 will be installed just to the northwest of soil borings SB11, SB12, and S13 to assess if the explosives and SVOCs detected in these soil borings have impacted the groundwater.

Monitoring well NDAHMW06 will be installed approximately 5 feet east of the eastern side of the building wall and 35 feet south, southeast of the northeast corner of the building to assess if there is groundwater contamination on the east side of the building.

Monitoring well NDAHMW07 will be installed approximately 50 feet to the northwest of MW02 to assess the downgradient extent of the metals detected at MW02.

The depth of these wells will be based on the water level measurements of the surrounding wells. The existing wells at NASD were constructed with two feet of screen above the water table. To be consistent, this design will also be used for all new wells. Estimated well depths and screened intervals are shown in Table 4-5. The new wells will be constructed using

10 feet of 0.01-inch slot PVC well screen coupled with 8 feet of 2-inch-diameter Schedule 40 PVC casing using flush joint threads.

4.3.3.2 Groundwater Sampling and Analysis

The three newly installed monitoring wells and two previously installed monitoring wells (MW-01 and MW-02) will be sampled for pesticides, explosives, perchlorate, SVOCs, total and dissolved metals to further evaluate these constituents detected during the previous sampling events (PA/SI). Unfiltered metals samples will be used for risk assessment whereas the filtered metals samples will be used for comparison purposes.

A round of water level measurements will be taken from all of the wells prior to sampling. If there is a surface water body next to the site, a staff gauge will be installed and its level will be recorded along with the wells. Afterwards, the wells will be purged and sampled using low-flow sampling techniques to minimize turbidity of the samples. All samples will be collected using a bladder pump as described in section 4.3.1.2. Table 4-13 presents the numbers of groundwater samples to be collected as part of this evaluation, including QA/QC samples. Section 2 of the Master Field Sampling Plan for the former NASD (CH2M HILL, January 2001) presents details regarding sampling, the required containers, preservatives, and holding times for groundwater and soil samples.

As previously discussed, VOCs have been eliminated from the analyte list based on data from the sampling and analysis phase of the PA/SI. Parameters to be measured and logged in the field include temperature, pH, DO, redox potential, conductivity, and turbidity.

TABLE 4-13
Groundwater Sample Parameters, Methods, and Quantities for AOC H
Former NASD, Vieques, Puerto Rico

Parameter	Method	No. of Samples	Equipment Blanks	Field Blanks	Field Duplicates	Matrix Spike/ Duplicate	Total Number of Samples
Pesticides	LL-OLCO2.1	5	1	1	1	2	10
Total Metals	ILM04.0	5	1	1	1	2	10
Dissolved Metals	ILM04.0	5	1	1	1	2	10
SVOCs	LL-OLCO2.1	5	1	1	1	2	10
Explosives	SW846 8330	5	1	1	1	2	10
Perchlorate	EPA 314.0	5	1	1	1	2	10

Notes:
Equipment blanks – one per day
Field Blanks – one per lot of ERB source water
Field Duplicates – one per every ten samples per matrix/medium or per batch, whichever is most frequent
Matrix Spike/Matrix Spike Duplicates – One per 20 samples per matrix or batch, whichever most frequent

4.3.3.3 Surface and Sub-surface Soil Sampling and Analysis

- Thirteen additional surface and sub-surface soil samples are proposed to be collected to define the horizontal and vertical extent of soil contamination in the source area. Parameters to be measured include explosives, SVOCs, pesticides, perchlorate, and metals. Figure 4-6 presents the soil sampling locations proposed for AOC H. The rationale for the selection of soil sampling locations is as follows:

- Three surface/subsurface soil samples will be collected at locations NDAHSS/SB17, SS18/SB18, and SS19/SB19, to the south of the building to assess the southern extent of metals and explosives previously detected in the soils.
- Surface and subsurface soil samples will be collected at locations SS/SB20, SS/SB21, SS/SB 22, SS/SB 23, and SS/SB 24 to assess the eastern extent of the metals previously detected in the soils.
- Surface and subsurface soil samples will be collected at locations SS/SB25 and SS/SB26 to assess the northern extent of contamination previously detected.
- Surface and subsurface soil samples will be collected at locations SS/SB27, SS/SB28, and SS/SB29 to assess the westward extent of the explosives, metals and SVOCs previously detected at SB-11, SB-12 and SB-13.
- Sampling techniques that will be employed for surface soil sampling includes either stainless-steel trowel sampling or stainless-steel hand auger sampling, depending on the nature of the material to be sampled. A stainless-steel trowel will typically be used to collect samples of loosely packed materials and a stainless-steel hand auger for densely packed materials. Surface soils will be collected at depths from surface to 6 inches. Subsurface soils will be collected at a depth of 4 to 6 feet or whenever bedrock is contacted, whichever comes first. These procedures for soil collection and transfer of soil to sample jars are described in the SOP for shallow soil sampling is presented as Attachment 2, Section 4.4.1 of the Master Work Plan for The Former NASD (CH2M HILL, January 2001).

Table 4-14 lists soil sample parameters and methods, and also includes the number of soil samples to be collected as part of this evaluation, including QA/QC samples. Details regarding the required containers, preservatives, and holding times for groundwater and soil samples are presented in Section 2 of the Master Field Sampling Plan for the Former NASD (CH2M HILL, January 2001).

4.3.3.4 Surface Water Sampling and Analysis

Five surface water samples will be collected and analyzed for total and dissolved metals, SVOCs, explosives, pesticides and perchlorate. In addition, a stilling well will be installed in the ditch northwest of the building to measure surface water levels. Figure 4-6 illustrates sample locations of the surface water samples. Note that NDAHSW05, south of Highway 200 may be located in a dry drainage ditch, in which case a surface water sample would not be available and only a surface soil sample would be taken.

Sample location NDAHSW05, will be located to the south side of Highway 200 to provide background surface water and sediment for the site.

Sample locations NDAHSW04, NDAHSW03, NDAHSW02, and NDAHSW01 will be collected to assess the downgradient surface water and sediment impacts at distances of 70 feet, 90 feet, 130 feet, and 150 feet, respectively, downgradient from the center of the site. Sample NDAHSW01 will be collected approximately 10 feet inside the naturally-occurring sand berm that forms at the mouth of the quebrada as it meets the ocean.

TABLE 4-14
Surface and Sub-surface Soil Sample Parameters, Methods, and Quantities for AOC H
Former NASD, Vieques, Puerto Rico

Parameter	Method	No. of Samples*	Equipment Blanks	Field Blanks	Field Duplicates	Matrix Spike/ Duplicate	Total Number of Samples
SVOCs	OLM04.2	26	2	1	2	2	33
Metals	ILM04.0	26	2	1	2	2	33
Explosives	8330	26	2	1	2	2	33
Perchlorate	EPA 314.0	26	2	1	2	2	33
Pesticides	OLM04.2	26	2	1	2	2	33

Notes* SW/SD-05 may be a dry arroyo, and thus this sample may not yield a SW sample and only a SS sample
Equipment blanks – one per matrix per day; blank for filtered samples is a filtration blank
Field Blanks – one per lot of ERB source water
Field Duplicates – one per every ten samples per matrix/medium or per batch, whichever is most frequent
Matrix Spike/Matrix Spike Duplicates – One per 20 samples per matrix or batch, whichever most frequent

Surface water samples will be collected from mid-depth into a pre-cleaned 2-liter glass jar provided by the laboratory or a kemmemer depending on the water depth. One set of samples will be field filtered and preserved in order to ascertain the contribution of the dissolved constituents for metals. One liter of the sample will be transferred to the total metals container and the other 1-liter will be field filtered and preserved for dissolved metals. Additional aliquot s will be collected for the other analyses and their appropriate sample containers filled and properly preserved. Table 4-15 presents the numbers of surface water samples to be collected as part of this evaluation, including QA/QC samples. Section 2 of the Master Field Sampling Plan for the former NASD (CH2M HILL, January 2001) presents details regarding sampling, the required containers, preservatives, and holding times for surface water samples.

TABLE 4-15
Surface Water Sample Parameters, Methods, and Quantities for AOC H
Former NASD, Vieques, Puerto Rico

Parameter	Method	No. of Samples*	Equipment Blanks	Field Blanks	Field Duplicates	Matrix Spike/ Duplicate	Total Number of Samples
SVOCs	OLM04.2	5	1	1	1	2	10
Explosives	8330	5	1	1	1	2	10
Perchlorate	314.0	5	1	1	1	2	10
Total Metals	ILM04.0	5	1	1	1	2	10
Dissolved Metals	ILM04.0	5	1	1	1	2	10
Pesticides	LL-OLCO2.1	5	1	1	1	2	10

Notes:
* SW/SD-05 may be a dry arroyo, and thus this sample may not yield a SW sample and only a SS sample
Equipment blanks – one per matrix per day; blank for filtered samples is a filtration blank
Field Blanks – one per lot of ERB source water
Field Duplicates – one per every ten samples per matrix/medium or per batch, whichever is most frequent
Matrix Spike/Matrix Spike Duplicates – One per 20 samples per matrix or batch, whichever most frequent

Parameters to be measured and logged in the field include temperature, pH, DO, redox potential, conductivity, and turbidity.

4.3.3.5 Sediment Sampling and Analysis

Five sediment samples are proposed to be collected at the surface water sample locations identified in Section 4.3.3.4 in order to assess the horizontal extent of sediment contamination, if present, from the source area. Figure 4-6 illustrates the proposed sediment sampling locations. All samples will be collected at a depth of 0 to 6 inches.

The applicable SOP for the collection of sediment samples is presented as Attachment 2, Section 4.4.1 of the Master Work Plan for The Former NASD (CH2M HILL, January 2001).

Table 4-16 provides a listing of sediment sample parameters and methods and also includes the number of sediment samples to be collected as part of this evaluation, including QA/QC samples. Details regarding the required containers, preservatives, and holding times for groundwater and soil samples are presented in Section 2 of the Master Field Sampling Plan for the Former NASD (CH2M HILL, January 2001).

TABLE 4-16
Sediment Sample Parameters, Methods, and Quantities for AOC H
Former NASD, Vieques, Puerto Rico

Parameter	Method	No. of Samples	Equipment Blanks	Field Blanks	Field Duplicates	Matrix Spike/ Duplicate	Total Number of Samples
SVOCs	OLM04.2	5	1	1	1	2	10
Explosives	8330	5	1	1	1	2	10
Perchlorate	314.0	5	1	1	1	2	10
Total Metals	ILM04.0	5	1	1	1	2	10
Pesticides	OLM04.2	5	1	1	1	2	10

Notes:
* SW/SD-05 may be a dry ditch, and thus this sample may not yield a SW sample and only a SS sample
Equipment blanks – one per matrix per day; blank for filtered samples is a filtration blank
Field Blanks – one per matrix per day
Field Duplicates – one per every ten samples per matrix/medium
Matrix Spike/Matrix Spike Duplicates – One per 20 samples per matrix

4.3.3.6 Hydraulic Tidal Study

Water level measurements will be collected from monitoring wells MW-1, MW-2, and MW-4 which were installed as part of the AOC H RI/FS to provide a broader perspective of groundwater flow. The water levels will be obtained by measuring the depth to water from a marked location on the top of casing which has been surveyed to the nearest 0.01 feet msl. Time series water level sampling utilizing a data logger will be performed along with a hydraulic tidal influence study in order to ascertain potential tidal effects on groundwater levels. Tidal fluctuations will be measured by installing one stilling well to the northwest of the building in the ditch. Continuous water level recorders will be installed in the three monitoring wells and stilling well to record at 10-minute intervals for a minimum of 24 hours to capture a full tidal cycle in the ditch. Water level fluctuations in the stilling well and monitoring wells will be compared graphically to determine if groundwater levels are tidally influenced.

4.3.4 AOC J – Former Operations Area Disposal Site

This site has been investigated and extensively sampled during the PA/SI. The avoidance survey by the MEC avoidance team found no live OE although empty shell casings were observed (see Table 4-1). Additional ordnance clearance will be performed during installation of new wells and soil borings at the site. In addition, an EM survey utilizing an EM-31 to map potential buried waste will be conducted along transects spaced 12.5 feet apart west of the ditch. Additional transects will be conducted on the water-filled ditch at 50 feet intervals beginning on the west bank and continuing east for 100 feet past the east embankment in order to delineate possible waste deposits.

Four monitoring wells were installed during the PA/SI at this site. Also, five surface soil samples, five subsurface soil samples, and five surface water and sediment samples were collected during the PA/SI.

4.3.4.1 Monitoring Well Installation

Five new monitoring wells will be added to the network of four monitoring wells that currently exist at the site. The four existing wells will be re-sampled to confirm PA/SI contaminants. All sample locations and well elevations will be surveyed in accordance with the Civil Surveying SOP included in the Master Work Plan. Monitoring wells will be installed using the hollow stem auger method to advance the well borings. In addition, continuous split spoon sampling will be conducted to document stratigraphy. The locations of the proposed monitoring wells are presented in Figure 4-7. The following summarizes the rationale for the new wells:

- Monitoring well NDAJMW05 will be installed east and downgradient of a recently discovered metal scrap pile during brush clearing activities to assess if the contaminants are migrating to the east of the drainage ditch and to better define the direction of groundwater flow along the ditch.
- Monitoring wells NDAJMW06 will be located approximately 80 feet north of NDAJMW01, near the west side of the drainage ditch to assess the downgradient extent of the contaminants detected in NDAJMW01 and NDAJMW04.
- Monitoring well NDAJMW07 will be installed just to the northeast of the debris piles identified at the south end of the site to assess if there are any groundwater quality impacts from these locations.
- Monitoring well NDAJMW08 will be installed along the access road and upgradient of the site to provide a characterization of the background groundwater quality.
- Monitoring well NDAJMW09 will be installed across the ditch on the east side of the site at approximately 100 feet northeast of NDAJMW01 to assess downgradient groundwater conditions and provide information on the hydraulic gradient across the site.

The depth of these wells will be based on the water level measurements of the surrounding wells. The existing wells at NASD were constructed with two feet of screen above the water table. To be consistent, this design will also be used for all new wells. Estimated well depths and screened intervals are shown in Table 4-5. The new wells will be constructed using

10 feet of 0.01-inch slot PVC well screen coupled with 2 feet of 2-inch-diameter Schedule 40 PVC casing using flush joint threads. The proposed location for these monitoring wells are illustrated in Figure 4-7.

4.3.4.2 Groundwater Sampling and Analysis

The five newly installed monitoring wells and four existing wells will be sampled for explosives, VOCs, SVOCs, pesticides, PCBs, perchlorate, total and dissolved metals to further evaluate these constituents detected during the previous sampling events (PA/SI) and measure extent. Unfiltered metals samples will be used for risk assessment whereas the filtered metals samples will be used for comparison purposes.

A round of water level measurements will be taken from all of the wells prior to sampling. If there is a surface water body next to the site, a staff gauge will be installed and its level will be recorded along with the wells. Afterwards, the wells will be purged and sampled using low-flow sampling techniques to minimize turbidity of the samples. All samples will be collected using a bladder pump as described in section 4.3.1.2. Table 4-17 presents the numbers of groundwater samples to be collected as part of this evaluation, including QA/QC samples. Section 2 of the Master Field Sampling Plan for the former NASD (CH2M HILL, January 2001) presents details regarding sampling, the required containers, preservatives, and holding times for groundwater and soil samples.

TABLE 4-17
Groundwater Sample Parameters, Methods, and Quantities for AOC J
Former NASD, Vieques, Puerto Rico

Parameter	Method	No. of Samples	Equipment Blanks	Field Blanks	Field Duplicates	Matrix Spike/ Duplicate	Total Number of Samples
Total Metals	ILM04.0	9	1	1	1	2	14
Dissolved Metals	ILM04.0	9	1	1	1	2	14
Explosives	SW846 8330	9	1	1	1	2	14
Pesticides	LL-OLCO2.1	9	1	1	1	2	14
PCBs	LL-OLCO2.1	9	1	1	1	2	14
VOCs	LL-OLCO3.2	9	1	1	1	2	14
SVOCs	LL-OLCO2.1	9	1	1	1	2	14
Perchlorate	EPA 314.0	9	1	1	1	2	14

Notes:
Equipment blanks – one per day
Field Blanks – one per lot of ERB source water
Field Duplicates – one per every ten samples per matrix/medium or per batch, whichever is most frequent
Matrix Spike/Matrix Spike Duplicates – One per 20 samples per matrix or batch, whichever most frequent

As previously discussed, pesticides, PCBs and VOCs have been eliminated from the analyte list based on data from the sampling and analysis phase of the PA/SI. Parameters to be measured and logged in the field include temperature, pH, DO, redox potential, conductivity, and turbidity.

4.3.4.3 Surface and Sub-surface Soil Sampling and Analysis

Five additional surface and five sub-surface soil samples are proposed to be collected in order to characterize the impacts to the soils adjacent to four of the debris piles located at the south end of the site. The surface soil samples will be collected at depths of 0-6 inches and the sub-surface soil samples will be collected at depths of 4-6 feet. Two soil borings of six feet will be installed adjacent to each of the three debris piles. The location of each of the borings are shown on Figure 4-7. Parameters to be measured include pesticides, PCBs, perchlorate, explosives, metals, VOCs and SVOCs. Table 4-18 includes the number of samples and the analytes proposed for the soil samples."

TABLE 4-18
Surface and Sub-surface Soil Sample Parameters, Methods, and Quantities for AOC J
Former NASD, Vieques, Puerto Rico

Parameter	Method	No. of Samples	Equipment Blanks	Field Blanks	Field Duplicates	Matrix Spike/ Duplicate	Total Number of Samples
SVOCs	OLM04.2	10	1	1	1	2	15
VOCs	OLM04.2	10	1	1	1	2	15
PCBs	OLM04.2	10	1	1	1	2	15
Pesticides	OLM04.2	10	1	1	1	2	15
Metals	ILM04.0	10	1	1	1	2	15
Explosives	8330	10	1	1	1	2	15
Perchlorate	314.0	10	1	1	1	2	15

Notes:
Equipment blanks – one per matrix per day; blank for filtered samples is a filtration blank
Field Blanks – one per lot of ERB source water
Field Duplicates – one per every ten samples per matrix/medium or per batch, whichever is most frequent
Matrix Spike/Matrix Spike Duplicates – One per 20 samples per matrix or batch, whichever most frequent

4.3.4.4 Surface Water Sampling and Analysis

Three surface water sample locations from the PA/SI will be re-sampled and analyzed for SVOCs, VOCs, PCBs, explosives, perchlorate, and total and dissolved metals. These are NDAJSW01, NDAJSW03, and NDAJSW05. Two new surface water samples will be collected at 80-foot intervals south of NDAJSW01. Thus, NDAJSW06 will be 80 feet south of NDAJSW01 and NDAJSW07 will be 160 feet south of NDAJSW01. Additionally, one surface water sample (NDAJSW08) will be collected from south of AOC J as the background data point (see Figure 4-8).

Surface water samples will be collected from mid-depth into a pre-cleaned 2-liter glass jar provided by the laboratory or with a kemmemer depending on the water depth. Samples will be analyzed for VOCs, SVOCs, pesticides, PCBs, explosives, perchlorate, total metals, and dissolved metals. For metals samples, one set of samples will be field filtered and preserved in order to ascertain the contribution of the dissolved constituents for metals. One liter of the sample will be transferred to the total metals container and the other 1-liter will be field filtered and preserved for dissolved metals. Table 4-19 presents the numbers of surface water samples to be collected as part of this evaluation, including QA/QC samples. Section 2 of the Master Field Sampling Plan for the former NASD (CH2M HILL, January 2001) presents details regarding sampling, the required containers, preservatives, and

holding times for surface water samples. A staff gauge will be installed in the ditch which runs along the east of AOC J. The surface water level will be collected and used with the groundwater elevation data to give a more complete picture of flow at the site.

TABLE 4-19
Surface Water Sample Parameters, Methods, and Quantities for AOC J
Former NASD, Vieques, Puerto Rico

Parameter	Method	No. of Samples*	Equipment Blanks	Field Blanks	Field Duplicates	Matrix Spike/ Duplicate	Total Number of Samples
SVOCs	OLM04.2	6	1	1	1	2	11
VOCs	LLOLCO3.2	6	1	1	1	2	11
PCBs	LLOLCO3.2	6	1	1	1	2	11
Pesticides	LLOLCO3.2	6	1	1	1	2	11
Explosives	8330	6	1	1	1	2	11
Perchlorate	314.0	6	1	1	1	2	11
Total Metals	ILM04.0	6	1	1	1	2	11
Dissolved Metals	ILM04.0	6	1	1	1	2	11

Notes:
Equipment blanks – one per matrix per day; blank for filtered samples is a filtration blank
Field Blanks – one per lot of ERB source water
Field Duplicates – one per every ten samples per matrix/medium or per batch, whichever is most frequent
Matrix Spike/Matrix Spike Duplicates – One per 20 samples per matrix or batch, whichever most frequent

Parameters to be measured and logged in the field include temperature, pH, DO, redox potential, conductivity, and turbidity.

4.3.4.5 Sediment Sampling and Analysis

Three sediment sample locations co-located with PA/SI surface water sample locations as described previously will be re-sampled and analyzed for total metals. These are NDAJSD01, NDAJSD03, and NDAJSD05. Two new sediment samples will be collected at 80-foot intervals south of NDAJSD01. Thus, NDAJSD06 will be 80 feet south of NDAJSD01 and NDAJSD07 will be 160 feet south of NDAJSD01. Additionally, one sediment sample (NDAJSD08) will be collected co-located with an upgradient surface water sample, as the background data point (see Figure 4-7). All sediment samples will be collected at a depth of 0 to 6 inches.

The applicable SOP for the collection of sediment samples is presented as Attachment 2, Section 4.4.1 of the Master Work Plan for the Former NASD (CH2M HILL, January 2001).

Table 4-20 lists sediment sample parameters and methods, and also includes the number of sediment samples to be collected as part of this evaluation, including QA/QC samples. Details regarding the required containers, preservatives, and holding times for groundwater and soil samples are presented in Section 2 of the Master Field Sampling Plan for the Former NASD (CH2M HILL, January 2001).

TABLE 4-20
Sediment Sample Parameters, Methods, and Quantities for AOC J
Former NASD, Vieques, Puerto Rico

Parameter	Method	No. of Samples	Equipment Blanks	Field Blanks	Field Duplicates	Matrix Spike/ Duplicate	Total Number of Samples
SVOCs	OLM04.2	6	1	1	1	2	11
VOCs	OLMO4.2	6	1	1	1	2	11
PCBs	OLMO4.2	6	1	1	1	2	11
Pesticides	OLMO4.2	6	1	1	1	2	11
Explosives	8330	6	1	1	1	2	11
Perchlorate	314.0	6	1	1	1	2	11
Total Metals	ILM04.0	6	1	1	1	2	11

Notes:
Equipment blanks – one per matrix per day; blank for filtered samples is a filtration blank
Field Blanks – one per matrix per day
Field Duplicates – one per every ten samples per matrix/medium
Matrix Spike/Matrix Spike Duplicates – One per 20 samples per matrix

4.3.4.6 Hydraulic Tidal Study

Water level measurements will be collected from monitoring wells MW-1, MW-3, and MW-4 which were installed as part of the AOC J RI/FS to provide a broader perspective of groundwater flow. The water levels will be obtained by measuring the depth to water from a marked location on the top of casing which has been surveyed to the nearest 0.01 feet msl. Time series water level sampling utilizing a data logger will be performed along with a hydraulic tidal influence study in order to ascertain potential tidal effects on groundwater levels. Tidal fluctuations will be measured by installing one stilling well to the east of the well NDAJMW01 in the ditch. Continuous water level recorders will be installed in the three monitoring wells and stilling well to record at 10-minute intervals for a minimum of 24 hours to capture a full tidal cycle in the ditch. Water level fluctuations in the stilling well and monitoring wells will be compared graphically to determine if groundwater levels are tidally influenced.

4.4 Sampling Equipment Decontamination

All non-disposable sampling equipment will be decontaminated immediately after each use. The applicable SOPs for the decontamination of personnel and equipment are presented in Attachment 2, Section 10.1.1 of the Master Work Plan, and are included with the FSP checklist. Tubing utilized in the low-flow sampling technique for sampling of groundwater will not be taken through the decontamination process since the tubing is pre-cleaned, and then disposed of after a single use.

4.4.1 Electronic Deliverable File Format

An offsite laboratory will analyze the samples collected for the RI/FS and will tabulate the results in an electronic format specified by CH2M HILL. The data validator will add data

validation qualifiers to the hard copy Form I's. CH2M HILL will receive an electronic file from the laboratory that will facilitate downloading into a database. CH2M HILL will enter the validation flags into the database and run quality assurance to ensure viability and completeness of the database along with a concurrence check between the hardcopy Form I's and the EDDs. Appendix B presents the EDD format required by CH2M HILL.

4.5 Sample Analysis and Validation

This task involves efforts related to the sample management and data validation. CH2M HILL will be responsible for tracking sample analysis and obtaining results from the laboratory. The analytical data generated during the field program will be validated by an independent data validation subcontractor according to the USEPA's *Contract Laboratory Program National Functional Guidelines for Organic* (October 1999) and *Inorganic Data Review* (2002) [NFG] (*Functional Guidelines*) utilizing USEPA Region 2 worksheets. Additionally, secondary 2-letter sub-qualifiers will be placed in a comments field so that the data user can ascertain why any result was flagged as it was. These sub-qualifiers are presented in Appendix C. The data validation subcontractor will receive a scope of work at the time a Request For Proposals (RFP) is released for competitive bidding.

4.5.1 Sample analysis

All analyses of soil, sediment, surface water, and groundwater will be conducted at a contracted laboratory that fulfills all requirements of the U.S. Navy's QA/QC Program Manual and USEPA's CLP and SW 846 (for methods not covered by CLP). The contracted laboratory will have provided their MDLs to CH2MHILL in their bid response so that a comparison will be made between screening criteria and the best available technology from the laboratory. The laboratory must follow the scope of work prepared by the project team. A signed certificate of analysis will be provided with each laboratory data package, along with a certificate of compliance certifying that all work was performed in accordance with the CLP scope of work (SOW). All analyses will be performed following the highest level of Navy guidance. Analyses will include the proper ratio of field QC samples recommended by Navy guidance for the DQOs.

This task includes checking the data from the laboratory and converting it into an electronic format that can be readily incorporated into the GIS data management system for The Former NASD. The laboratory subcontractor will receive a scope of work at the time an RFP is released for competitive bidding.

4.5.2 Field Quality Control Procedures

Field QC samples include duplicates and blanks. Field duplicates measure the precision of the field sampling crew and provide an indication of the homogeneity of the sample matrix. The various blanks collected in the field are collected in order to ascertain possible sources of sample contamination. The QAPP provides details with regard to the number and frequency of field QC samples to be collected during the investigation.

4.5.3 Blanks

Blanks provide a measure of cross-contamination sources, decontamination efficiency, and other potential errors that can be introduced from sources other than the sample.

American Society for Testing and Materials (ASTM) Type II water will be used for blanks. Four types of blanks can be generated during sampling activities: trip blanks, field blanks, equipment blanks, and temperature blanks.

Trip blanks are utilized to monitor VOC contamination. Every cooler that has VOC water samples will have a VOC trip blank.

One field blank will be collected per lot of source water used for decontamination. A single source should be used for these field efforts. However, if sampling events extend beyond 1 week (5 working days) or for windy and dusty field conditions, the number of field blanks may be increased. Field blanks are used to determine the chemical quality of water used for decontamination.

One equipment blank should be collected per day, per type of sampling equipment. Equipment blanks provide an indication of the efficiency of the decontamination procedure and indicate what possible contaminants may be artifacts from the decontamination process and not attributed to site activities.

USEPA has recently requested that a temperature blank be included in each cooler containing samples for CLP analyses so that the laboratory can record the temperature without disturbing the samples. The temperature blank will be labeled, but will not be given a sample number nor will it be listed as a sample on the chain-of-custody (COC) form. The temperature reading will be recorded on the COC or on a sample receipt checklist.

4.5.4 Duplicates

Field duplicate samples will be collected at a frequency of one field duplicate per 10 field samples, per matrix. The locations from which the duplicates are taken will be selected randomly. Each duplicate sample will be homogenized and split evenly into two sample containers and submitted for analysis as two independent samples. This QC sample measures sampling precision and matrix homogeneity or heterogeneity.

4.5.5 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

MS/MSD samples will be collected at a frequency of one MS/MSD set for every 20 field samples, per matrix, collected. The MS/MSD measurement provides measurements of accuracy and precision as they relate to a matrix. The percent recoveries of the MS and MSD, that is, the amount recovered of the amount spiked, provides the matrix accuracy statistic. The comparison of the MS/MSD recoveries (CLP) or concentrations (SW846) provide the measurement of matrix precision in percent relative standard deviation units.

4.5.6 Sample Designation

Sampling locations and samples collected during the investigation will be assigned unique designations to allow the sampling information and analytical data to be entered into the existing Geographic Information System (GIS) Data Management system. The existing

designation scheme for the former NASD will be followed by field personnel. The following sections describe the sample designation specifications.

4.5.6.1 Specifications for Field Location Data

Field station data is information assigned to a physical location in the field at which some type of sample is collected. For example, a soil boring that has been installed will require a name that will uniquely identify it with respect to other soil boring locations, or other types of sampling locations. The station name provides for a key in the database to which any samples collected from that location can be linked, to form a relational database.

A listing of the location identification numbers will be maintained by the field team leader, who will be responsible for enforcing the use of the standardized numbering system during all field activities. Each station will be designated by an alphanumeric code that will identify the station location by facility, site type, site number, station type, and sequential station number. Table 4-21 documents the scheme that will be used to identify field station data.

TABLE 4-21
Field Station Scheme

First Segment	**Second Segment**	
Facility, Station Type, Site Number	**Station Type**	**Station Number, Qualifier**
AAANNN	**AA**	**NNNA**
Facility: ND = NASD Station Type: W=SWMU A = AOC Site Number: 06 – SWMU 6 07 – SWMU 7 H - AOC H J – AOC J	Station Type: SB = Subsurface Soil Sample Location SD = Sediment Sample Location SS = Surface Soil Sample Location MW = Monitoring Well SW = Surface Water Sample Location GW = Groundwater Sample Location Station Number: Sequential Station Number (01, 02, 03...) Qualifier: S = Shallow R = Replaced D = Deep K = Background	

Notes:
"A" = alphabetic
"N" = numeric

4.5.6.2 Specifications for Analytical Data

Analytical data will be generated through sampling of various media at NASD. Each analytical sample collected will be assigned a unique sample identifier. The scheme used as a guide for labeling analytical samples in the field is documented below. The format that will be used for electronic deliverables from the analytical laboratory and the data validator is documented below.

4.5.6.3 Sample Identification Scheme

A standardized numbering system will be used to identify all samples collected during water, soil, and sediment sampling activities. The numbering system will provide a tracking procedure to ensure accurate data retrieval of all samples taken. A listing of the sample identification numbers will be maintained by the field team leader, who will be responsible for enforcing the use of the standardized numbering system during all sampling activities. Sample identification for all samples collected during the investigations will use the following format.

Each sample will be designated by an alphanumeric code that will identify the facility, site, matrix sampled, and contain a sequential sample number. The QA/QC samples will have a unique sample designation. Table 4-22 documents the general guide for sample identification. If one qualifier is pertinent to the sample ID but another is not, only the Table 4-21 applicable qualifiers will be used. A non-utilized character space does not have to be maintained.

4.6 Data Validation

Analytical results will be validated by CH2M HILL subcontractors approved by the Navy. Data validators will use USEPA's Region II worksheets utilizing the USEPA guidance document *Contract Laboratory Program National Functional Guidelines for Organic (1999) and Inorganic Data Review (2002)[NFG]*) (*Functional Guidelines*). Areas of review include (when applicable to the method) holding time compliance, calibration verification, blank results, matrix spike precision and accuracy, method accuracy as demonstrated by laboratory confirmation samples (LCSs), field duplicate results, surrogate recoveries, internal standard performance, and interference checks. A Region II data review worksheet will be completed for each method of each data package and any non-conformance will be documented. This data review and validation process is independent of the laboratory's checks and focuses on the usability of the data to support the project data interpretation and decision-making processes.

Data that are not within the acceptance limits will be appended with a qualifying flag, which consists of a single or double-letter abbreviation that reflects a problem with the data. Primary and secondary (descriptive) flags are presented and defined in Appendix C.

TABLE 4-22
Sample Designation Scheme

First Segment	Second Segment	Third Segment	
Facility, Station, and Site Number	**Sample Type**	**Sample Location + Sample Qualifier**	**Additional Qualifiers (sample depth, sampling round, etc.)**
AAANN	**AA**	**NNNA or NNAA**	**ANN or NNNN**
Facility: ND = NASD Station Type: W = SWMU A = AOC Site Number: 06 – SWMU 6 07 – SWMU 7 H - AOC H J - AOC J		Sample Type: DS = Direct Push - Soil DW = Direct Push - Water SD = Sediment SS = Surface Soil TB = Trip Blank EB = Equipment Blank FB = Field Blank FD = Field Duplicate Sample Location: 1. Station Samples (NNA) NNA - refers to sequential station number NNA - letter qualifier for Deep, Shallow, or Composite, sample (if applicable). 2. QC Samples (NNN) NNN – numbered sequentially for each type of blank (i.e., 1, 2, etc.) collected for that day's sampling NNN - refers to month of sampling event Sample Qualifiers: F = filtered sample P = duplicate sample K = background sample	Additional Qualifiers: 1. Monitoring Well Groundwater Sample (refers to sampling round for that well): R01 – Round 1 R02 – Round 2 R03 – Round 3 2. Direct Push Subsurface Sample (refers to depth of sample): Enter depth of top of sample interval 3. QC Samples NNNN – refers to day and year of sampling event

Notes:
"A" = alphabetic
"N" = numeric

4.7 Data Quality Evaluation

Analytical data will be collected during this investigation in the form of laboratory analytical results. The electronic data deliverable will be checked against the hard copy results to ensure agreement and comparability. The database will then be populated with the data validation subcontractor's primary and secondary qualifiers. Post validation queries will then be applied to the populated database to ensure that the populated data is logical and has no apparent anomalies. Once this is accomplished the data quality evaluation (DQE) queries are generated and reviewed by the project chemist for discrepancies that logic may not discover. At this point, the database is deemed complete and ready to generate project reports and the final DQE queries for the data quality evaluation technical report.

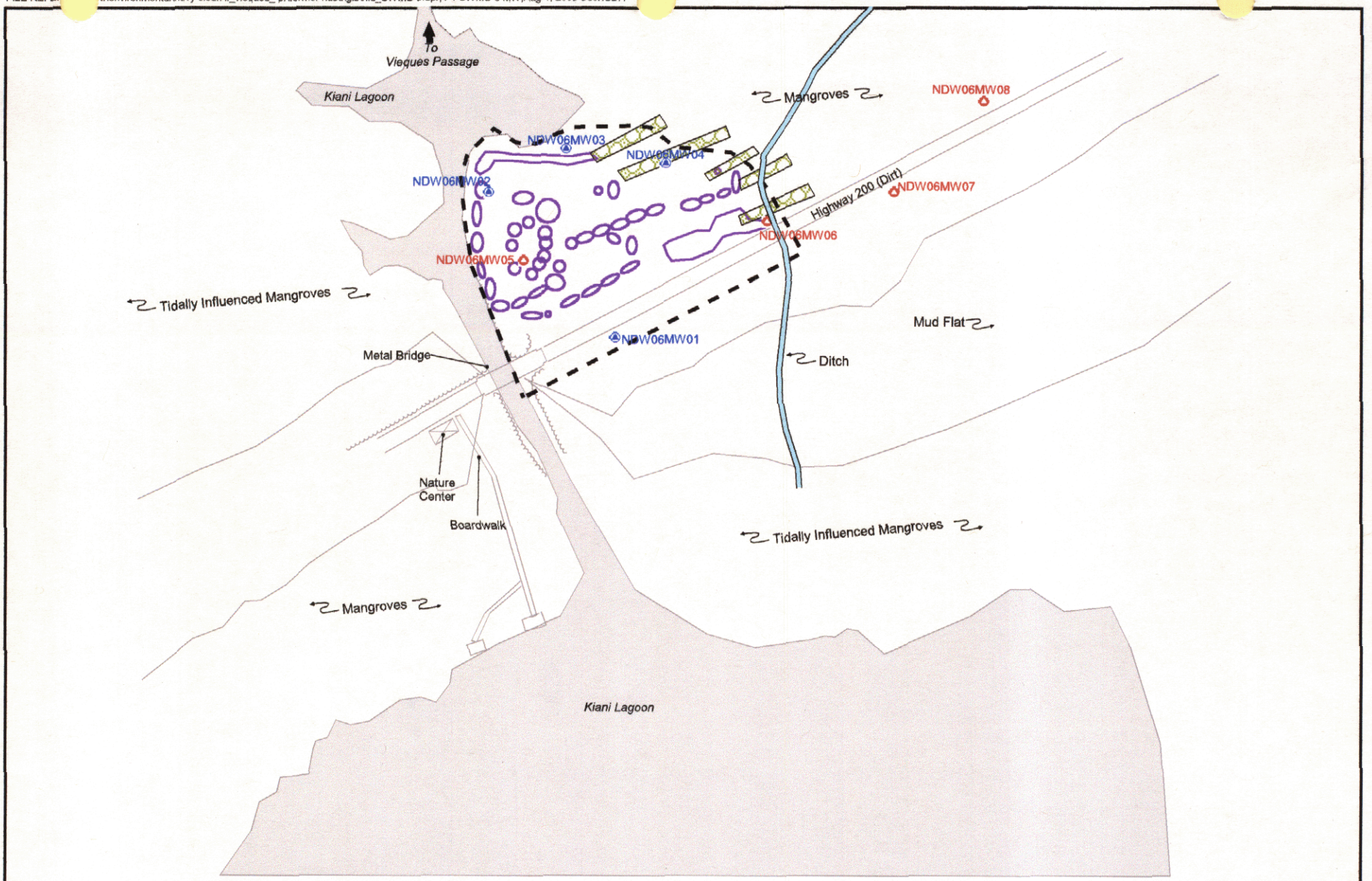
The purpose of the data quality evaluation process is to assess the effect of the overall analytical process on the usability of the data. The two major categories of data evaluation are laboratory performance and matrix interferences. Evaluation of laboratory performance is a check for compliance with the method requirements; either the laboratory did, or did not, analyze the samples within the limits of the analytical method. Evaluation of matrix interferences is more subtle and involves the analysis of several areas of results including surrogate spike recoveries, matrix spike recoveries, and duplicate sample results.

The DQE deliverable is a DQE Technical Memorandum (TM) that can be used by the project team to readily understand project-specific data usability. Topics to be addressed in the DQE TM include the following:

- *Potential blank contamination* – the effect on the usability of data for targets detected in samples which may have been detected in field or laboratory blanks.
- *Laboratory accuracy and precision* – evaluation of the recovery(ies) for blank spike/blanks spike duplicate (or LCS/LCSD) samples for method precision and accuracy
- *Tuning and calibration* - evaluation of all calibration requirements and criteria in order to evaluate percent completeness and usability per analytical fraction and analyte
- *Potential matrix interferences* – evaluation of the matrix accuracy and precision for surrogates, internal standards, MS/MSDs, and field duplicate sample results. Serial dilutions, method of standard additions, and degradation checks are also evaluated.
- *Assessment of PARCCs* – comparison of data validation (DV) findings with PARCCs (precision, accuracy, representativeness, comparability, and completeness)

The DQE contains a detailed discussion of all these areas and contains detailed tables that present data to the user for the decision making process.

FILE REFER t:\environmental\navy clean ii_vieques_ pr\former nasd\gis\rifs_SWMU 6.apr,4-1 SWMU 6 MW,Aug 1, 2003 User:SDH



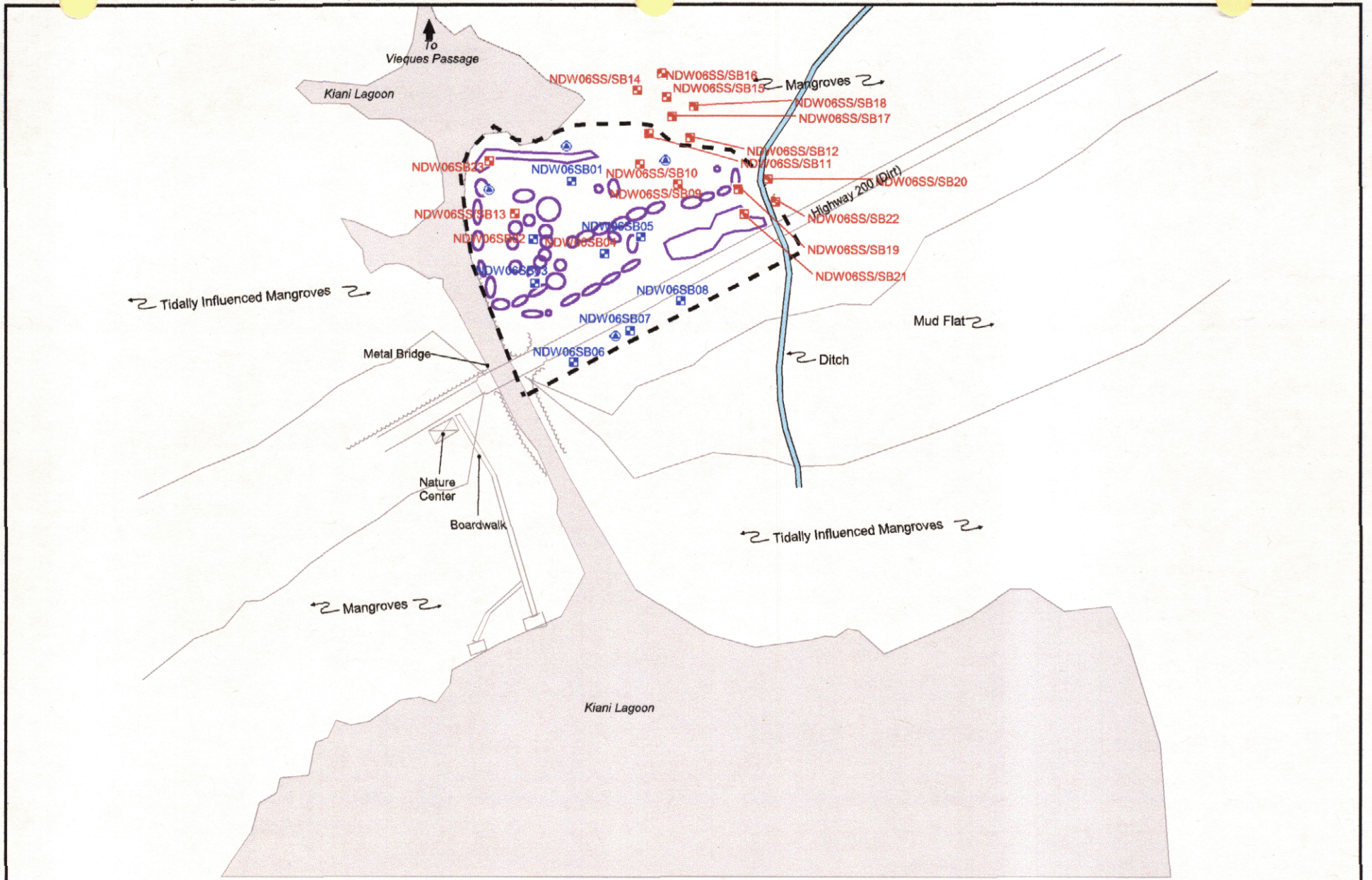
LEGEND

- Existing Monitoring Wells
- Proposed Monitoring Wells
- Water Level Recorder For Tidal Study
- Approximate SWMU Boundary Based on Geophysics
- Debris Boundaries Based on Visual Observations
- Ditch
- Proposed Geophysical Transects

N

100 0 100 Feet

Figure 4-1
SWMU 06 Mangrove Disposal Site
Proposed Monitoring Well Locations
Former NASD, Vieques Island, Puerto Rico



LEGEND

- Existing Monitoring Wells
- Existing Soil Borings
- Proposed Soil Borings
- Approximate SWMU Boundary Based on Geophysics
- Debris Boundaries Based on Visual Observations
- Ditch

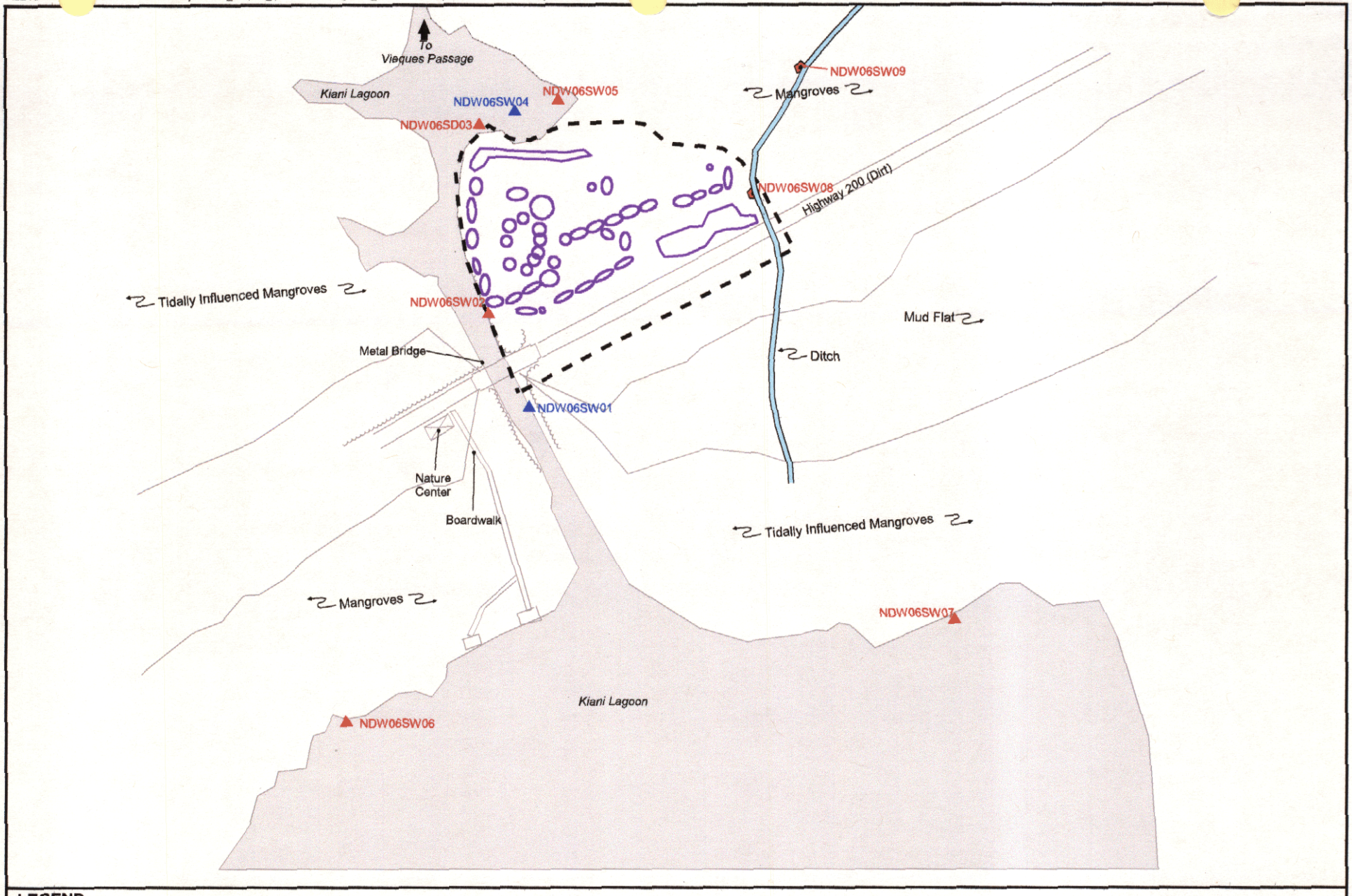
N

90 0 90 Feet

Figure 4-2
SWMU 06 Mangrove Disposal Site
Proposed Soil Boring Locations
Former NASD, Vieques Island, Puerto Rico

CH2MHILL

FILE REFER t:\environmental\navy clean ii_vieques_ pr\former nasd\gis\rifs_4-1 SWMU 6.apr,4-3SWMU 6 SW,Aug 1, 2003 User:SDH



LEGEND

- Proposed Surface Water
- Existing Surface Water
- Existing Surface Water Site to be Resampled
- Approximate SWMU Boundary Based on Geophysics
- Debris Boundaries Based on Visual Observations
- Ditch

N

90 0 90 Feet

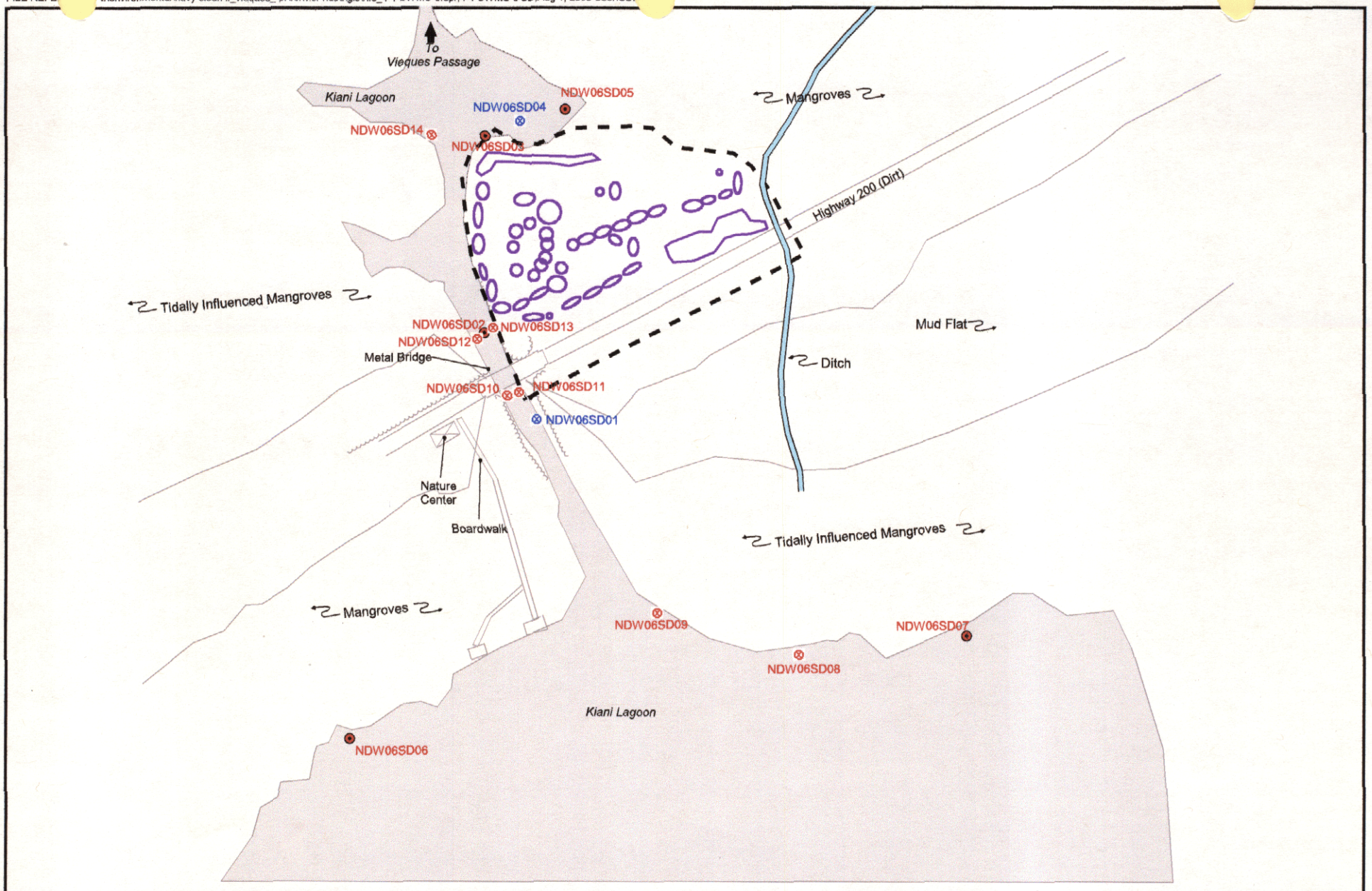
Figure 4-3
SWMU 06 Mangrove Disposal Site
Proposed Surface Water Locations
Former NASD, Vieques Island, Puerto Rico

CH2MHILL

● Proposed Surface Water/Sediment Sample Location

FIGURE 4-3A
Location of Surface Water/Sediment Background Samples for SWMU 6
Former Naval Ammunition Support Detachment, Vieques Island

CH2MHILL



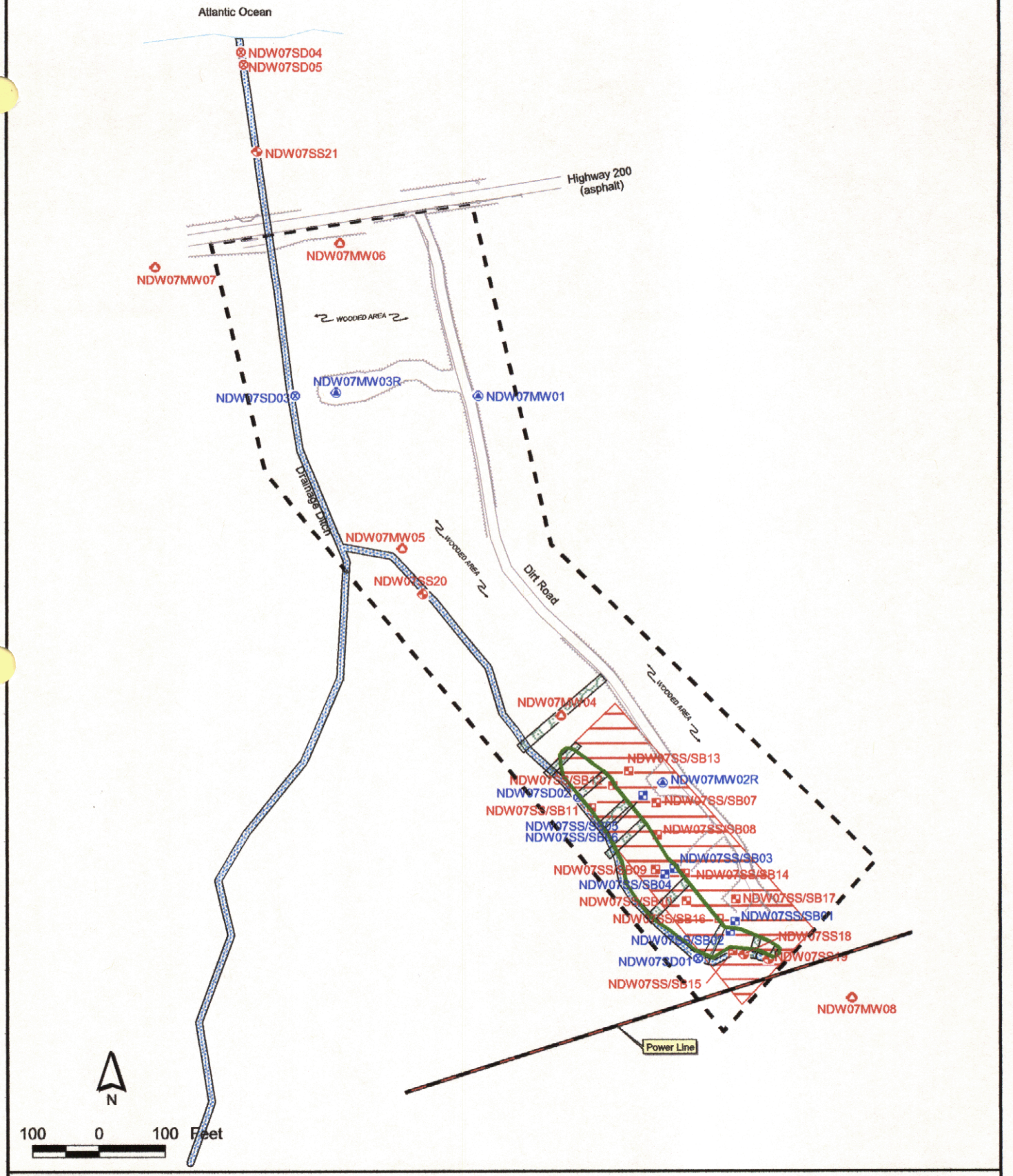
LEGEND

- Existing Sediment
- Proposed Sediment
- Existing Surface Water Site to be Resampled
- Approximate SWMU Boundary Based on Geophysics
- Debris Boundaries Based on Visual Observations
- Ditch

N

80 0 80 Feet

Figure 4-4
SWMU 06 Mangrove Disposal Site
Proposed Sediment Locations
Former NASD, Vieques Island, Puerto Rico

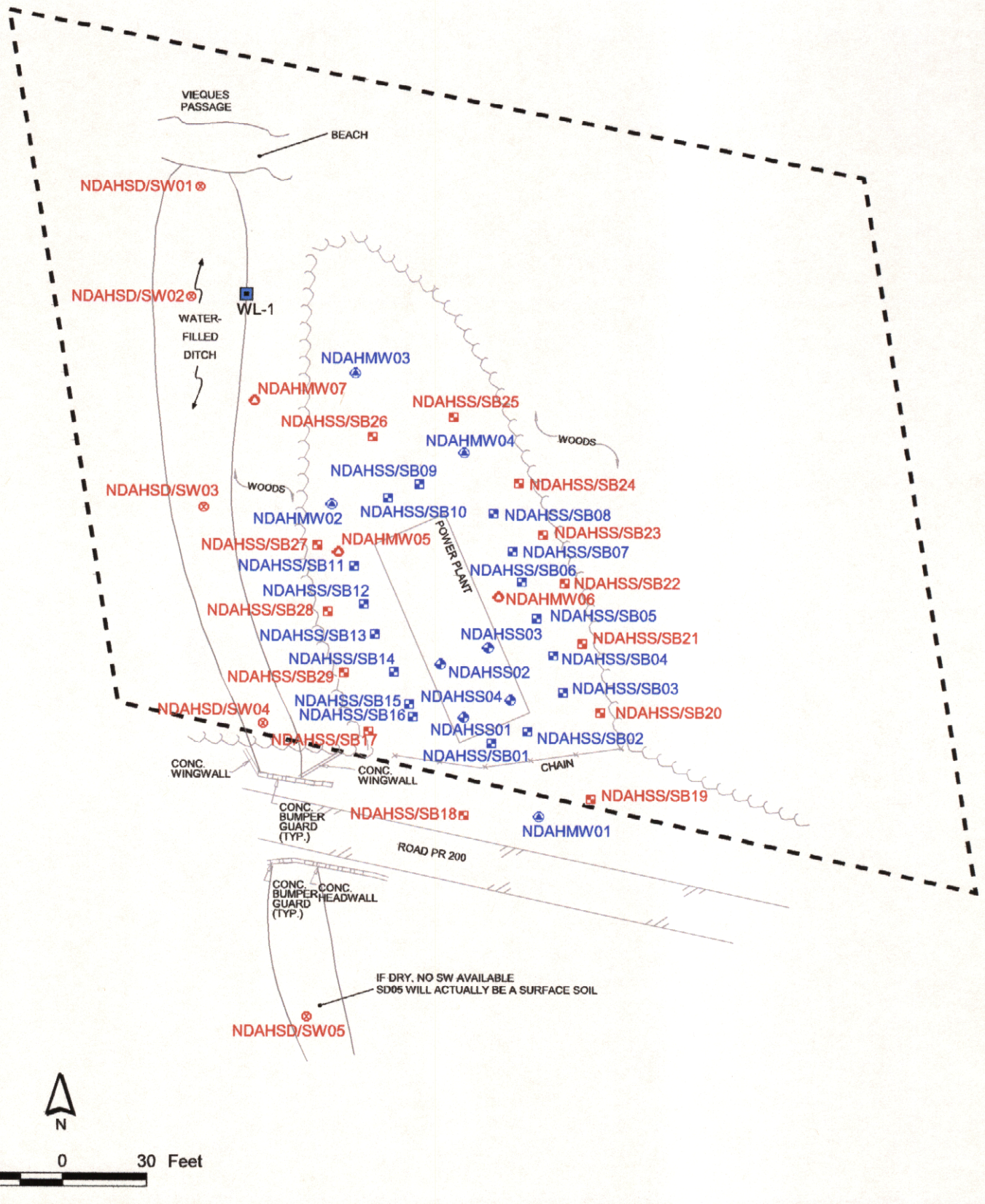


LEGEND

- Existing Monitoring Wells
- Proposed Monitoring Wells
- Existing Sediment
- Proposed Sediment
- Proposed Surface Soil
- Existing Surface/Subsurface Soil Borings
- Proposed Surface/Subsurface Soil Borings
- AOC/SWMU Boundary
- Approximate Waste Area Boundaries Based on Visual Inspection
- Geophysical Survey Area
- Geophysical Transect

Figure 4-5
SWMU 07 Former Disposal Site
Proposed Soil Sample,Sediment Sample,
and Monitoring Well Locations
Former NASD, Vieques Island, Puerto Rico

CH2MHILL

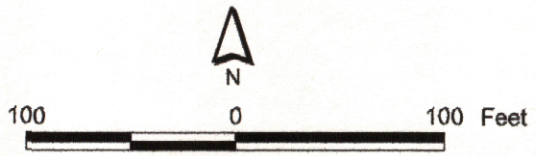


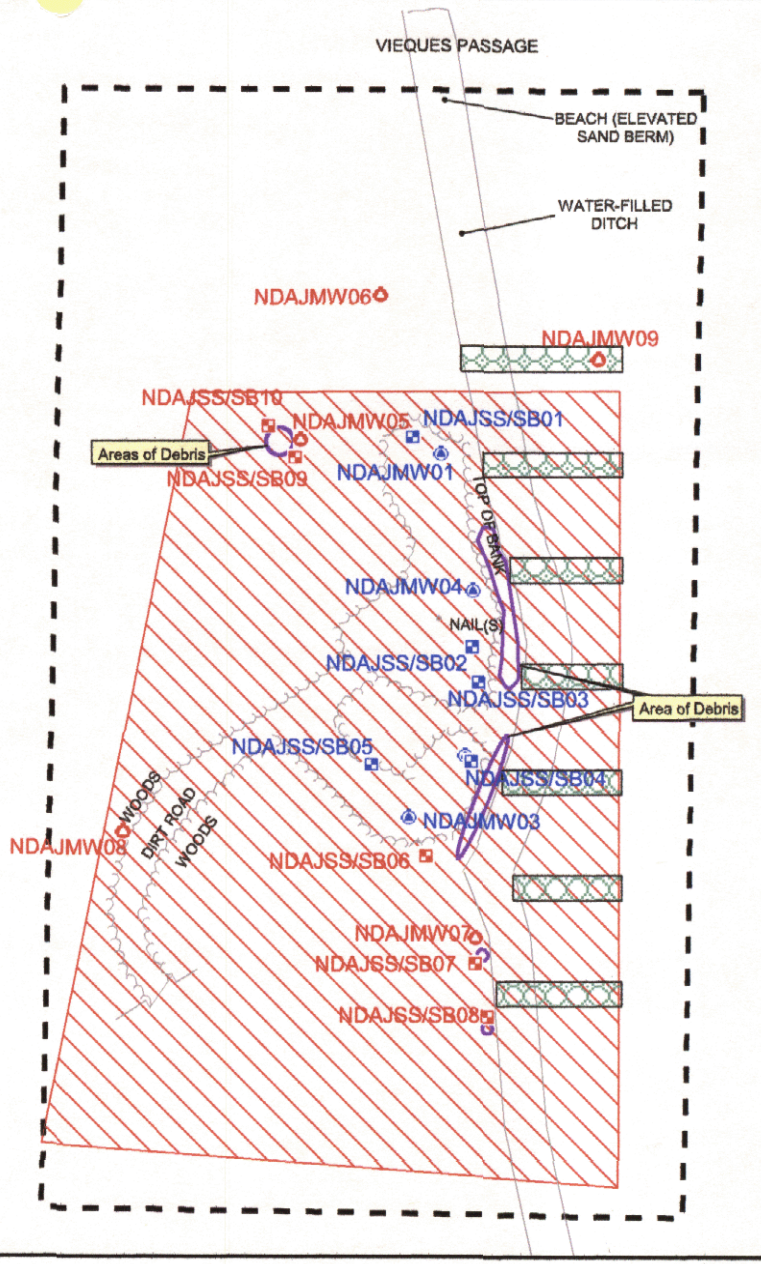
LEGEND

- Existing Monitoring Wells
- Proposed Monitoring Wells
- Existing Surface Soil
- Proposed Surface Soil
- Existing Surface/Subsurface Soil Borings
- Proposed Surface/Subsurface Soil Borings
- Proposed Sediment/Surface Water
- AOC/SWMU Boundary
- Water Level Recorder For Tidal Study

Figure 4-6
AOC H Former Power Plant (Fire Training Area)
Proposed Soil Sample, Monitoring Well, Sediment and Surface Water Sample Locations
Former NASD, Vieques Island, Puerto Rico

CH2MHILL





LEGEND

- Existing Monitoring Wells
- Proposed Monitoring Wells
- Geophysical Survey Area
- Debris Boundaries Based on Visual Observations
- AOC/SWMU Boundary With Buffer Zone
- Existing Surface/Subsurface Soil Borings
- Proposed Surface/Subsurface Soil Borings
- Geophysical Transects

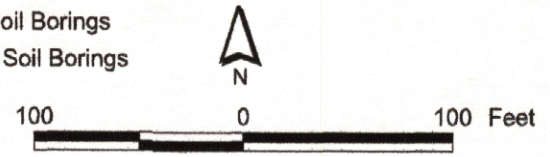
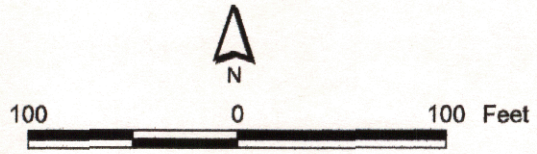
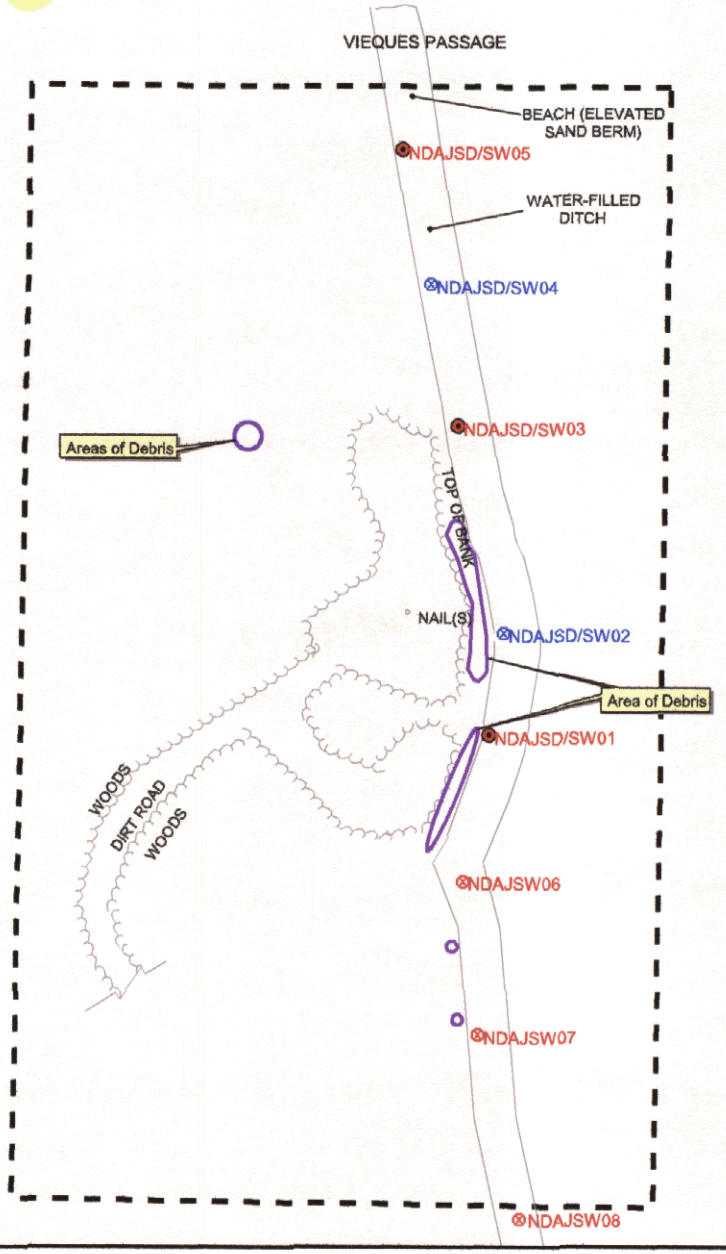


Figure 4-7
AOC J Former Operations Area Disposal Site
Proposed Monitoring Well and Soil Locations
Former NASD, Vieques Island, Puerto Rico

CH2MHILL





LEGEND

- Existing Sediment/Surface Water
- Proposed Sediment/Surface Water
- Existing Sediment/Surface Water To Be Resampled
- Debris Boundaries Based on Visual Observations
- AOC Boundary With Buffer Zone

Figure 4-8
AOC J Former Operations Area Disposal Site
Proposed Sediment and Surface Water Locations
Former NASD, Vieques Island, Puerto Rico

CH2MHILL

SECTION 5

Human Health and Ecological Risk Assessment (HH&ERA)

An HH&ERA will be conducted in accordance with the USEPA Risk Assessment Guidance for Superfund (RAGS). The results of the HH&ERA will be incorporated into the RI Report.

5.1 Objective of the HHERA

A baseline human health and ecological risk assessment will be conducted at the four sites identified for RI/FS within the Former NASD, Vieques Island, Puerto Rico, following USEPA guidance and any PREQB guidance or policy. The risk assessment will document the potential adverse effects to human health and the environment, under both current and future land use conditions. The results of this risk assessment will serve as the basis for site decisions by the site risk managers for these sites.

5.2 Human Health Risk Assessment Approach

The following documentation discusses the general approach for the human health risk assessment to be conducted at AOCs H, and J, and SWMUs 6 and 7 within NASD. The risk assessment will use methods recommended by the USEPA guidance as listed in the following and other applicable regional USEPA (Region II) guidance:

- United States Environmental Protection Agency, 1989. *Risk Assessment Guidance for Superfund (RAGS), Volume I, Human Health Evaluation Manual (Part A).* EPA/540/1-89/002.
- United States Environmental Protection Agency, 1998. *Risk Assessment Guidance for Superfund (RAGS), Volume I, Human Health Evaluation Manual (Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments).* OSWER 9285.7-01D. January 1998.
- United States Environmental Protection Agency, 1989. *Risk Assessment Guidance for Superfund (RAGS), Volume II, Environmental Evaluation Manual.* EPA-540/1-89/001.
- United States Environmental Protection Agency, 1990. *Guidance for Data Usability in Risk Assessment.* EPA/540/G-90/008.
- United States Environmental Protection Agency, 1997. *Exposure Factors Handbook.* August 1997.//www.epa.gov/ncea/exposfac.htm.
- United States Environmental Protection Agency, 1992. Land Use in the CERCLA Remedy Selection Process. OSWER 9355.7-04.

The human health risk assessment will include the following major components in the evaluation process:

- Identification of contaminants of potential concern (COPC)
- Exposure assessment
- Toxicity assessment
- Risk characterization and uncertainty evaluation
- Site versus background concentrations and risks

A CSM will be developed for an overview of site conditions, potential migration pathways, receptors, and exposure routes identification purposes. This will serve as the basis for the exposure pathway evaluations in the human health (and ecological) risk assessments.

As appropriate, a discussion of remedial goal options (RGOs) will be included for the sites presenting excess risk or hazard, for risk management decision purposes.

A site description of each of the four sites was previously presented in this work plan (see Section 2).

5.2.1 Identification of Contaminants of Potential Concern

Existing analytical data from each of the sites will be evaluated for a quantitative risk assessment by identifying chemicals that are above screening levels. A similar screening comparison process to the previous PA/SI phases will be used. The screening criteria will use the latest updated PRG values from EPA Region 9, MCLs from EPA, website, and the latest available ecological criteria for surface water and sediments at the time of the RI report preparation. The current version of this criteria is included in Appendix G.

Data are obtained in electronic format and these data will be ensured to have been through a DQE process. The COPC that represent site conditions will be selected using the monitoring data from each site. The selection process will include chemicals that are a direct exposure concern. A set of COPC that may be of interest from migration to groundwater, air, and/or surface water bodies will also be identified to address future migration concerns.

The groundwater data from unfiltered samples will be used for quantitative risk assessment. Any filtered samples will be used to assess to support the data interpretation of unfiltered groundwater samples.

Surface water and sediment samples will be evaluated for direct exposure to human receptors using recreational scenario. The recreational receptors are the nearby residents with similar exposure durations to residential receptors.

5.2.2 Exposure Assessment

An exposure assessment will evaluate the potential exposure to the site media and identify the potential receptor population for each site. The exposure assessment will be conducted to identify potential exposure pathways for human receptors, assess the potential routes of exposure, and document the behavior of the assumed receptor into exposure factors for quantitation of the potential exposure. The specific assumptions will be discussed with the risk assessors from reviewing agencies prior to inclusion in the quantitative risk

assessments, preferably in a meeting. A conceptual site model will be developed to identify the source, migration pathways, and the potential receptors at each site.

The site and its surrounding land use will be documented in the best possible manner, as the onsite land use is subject to change in the near future due to the property leasing that is planned. The offsite well information will be documented based on the available information from local government records. Land use assumptions for current and future land uses at each site and area surrounding areas of the four RI sites will be discussed. If the information from the Department of the Interior (DOI) regarding future land use plans for their property within NASD is available, it will be used in the exposure assessment. In addition the EPA guidance document "Land Use in the CERCLA Remedy Selection Process" will be consulted. Since the future land use may be unlimited, a default residential scenario will be evaluated for each site. Although a residential scenario will be evaluated, its applicability for the site management decisions shall be carefully assessed.

A preliminary list of the default exposure factors to be used in the future industrial and residential exposure scenario risk estimations are included in this section (Tables 5-1, 5-2, and 5-3). Additionally, current exposure scenarios will include a site-specific most likely use scenario and will be evaluated for each site, as appropriate. A recreational scenario will also be evaluated for all four sites.

Additional exposure factors will be developed to address the various scenarios such as wildlife photography, hunting, fishing, nature center visitors type future exposure scenarios will be included for evaluation, once areas within which such land use is identified by DOI.

Fate and transport of the COPC identified for each media will be evaluated and discussions will be provided. The fate and transport discussions will be qualitative and potential downgradient receptor points are included for sampling in this work plan.

The dose (chronic daily intakes [CDIs]) will be estimated using exposure point concentrations for each receptor and exposure route for the identified complete exposure pathways. Exposure pathways for risk assessment will be selected based on the site activities and surrounding area and the site conceptual model developed prior to risk assessment. Exposure pathways to be quantified will be determined based on USEPA guidance and will include the direct exposure pathways to soil, groundwater, sediments, and surface water as appropriate. Appropriate representative exposure pathways will be included for quantitative analysis and other potentially complete, less–conservative pathways will be discussed qualitatively, as appropriate.

The exposure point concentrations will be the upper 95% confidence limit estimates on the mean concentrations (UCL95%). The non-detect samples will be included at half the detection limit levels in these UCL95% estimates. These estimations will be performed using the underlying data distributions (normal versus log-normal), according to the USEPA guidance. The lower of the maximum detected concentration and the UCL95% estimated will be selected as the exposure point concentrations.

Within each of the four areas described in Section 2.1, risk assessment will be performed for three exposure scenarios:

1. The potential residential exposure scenario will be evaluated in a manner similar to that performed for the Main Installation. A ½-acre lot will be positioned in the most conservative configuration that intersects samples with the highest concentrations of COPCs. The risk assessment will be performed using maximum concentrations at these intersected sample locations.

2. The industrial scenario will be evaluated using all data within each area. A UCL95 will be calculated using all surface and subsurface data within each of the three geographic areas.

3. A recreational scenario would include site-specific future land use based scenarios identified by DOI.

Both surface and subsurface soils will be evaluated for human health exposure. Subsurface soils within the uppermost 6 feet will be evaluated for direct exposure during excavation. In addition, exposures to vapor inhalation at the surface and within building foundations will also be evaluated.

A fate and transport evaluation will include discussion of environmental behavior of the COPC identified during the nature and extent investigations in the surface and subsurface soils, sediment, and surface water, and potential impacts to site groundwater. The behavior of the chemicals shall be determined by both individual chemical properties, as well as by facility characteristics including water flow velocity, soil permeability, infiltration, temperature, and presence of conditions that support microbial population. Potential pathways—including air emissions, transport, or persistence—shall be assessed based on site-specific information and chemical properties. Fate and transport evaluation will include potential offsite impacts from the site contaminants by evaluating the site COPC and their potential for offsite migration through groundwater or surface runoff or volatilization from the site media. However, this pathway is important for VOCs. The PA/SI results did not indicate presence of significant amounts of VOCs in any of these four RI sites. This will be a qualitative evaluation. The groundwater monitoring data will serve as the indicator for quantitative assessment of the potential migration. No quantitative modeling will be performed as part of this fate and transport evaluation.

5.2.3 Toxicity Assessment

The human health evaluation will include a toxicity assessment section that compiles the toxicity criteria for risk and hazard index estimates. The toxicity criteria will be obtained from the USEPA toxicity databases (e.g., IRIS, and HEAST). Any interim values from USEPA available through other sources (e.g., USEPA Region IX PRG tables) will be used in the absence of a value in the USEPA toxicity databases. Uncertainties associated with the toxicity criteria estimations will be discussed. The target organs for the selected toxicity factors will be selected from the existing toxicity databases, as suggested by USEPA. The toxicity equivalency factors (TEFs) will be used for PAHs and dioxins as appropriate. For PCBs, three sets of toxicity factors are available. The conservative set of toxicity factors will be used for risk estimations.

5.2.4 Risk Characterization

The exposure and toxicity information from the previous sections will be integrated in this section to estimate the potential risks and health indices (HIs). The estimated risks and HIs represent the site (area) being investigated for site-specific risk management decisions. The cumulative risks and HIs will be compared against the acceptable risk ranges. Summary and conclusions will be provided for each of the receptor populations and sites. Risks will be totaled by medium and combined risks across media and pathways will be presented as appropriate.

5.2.5 Uncertainty Analysis

A qualitative discussion of uncertainty associated with each of the sites will be discussed. The background levels for inorganic chemicals will be included in this portion of the report to determine if the risk characterization included chemical that are not specific to the site, rather part of the general background. Final site human health risk and related impacts discussions will identify site operation related chemicals.

5.3 Ecological Risk Assessment Approach

An ecological risk assessment (ERA) will be conducted to document the potential adverse effects to the environment as a result of contamination present at the 4 RI sites at NASD, Vieques. The USEPA's program guidance for ecological risk assessments will be the primary ERA guidance (USEPA, 1997). The stepwise process outlined in this guidance will serve as the basic framework for the ERA portion of the RFI. The initial data collected during the PA/SI and this RI/FS will be used to assess ecological risks following existing EPA guidance. The need for additional biological sampling will be identified during this evaluation process, depending on the results of the screening-level baseline ecological risk assessment described in Steps 1 through 3 below.

5.3.1 Step 1 - Screening Level Problem Formulation and Ecological Effects Evaluation

This is the initial step in the ERA and will include all the elements of a problem formulation and ecological effects analysis but on a screening level. The results of this step will support the exposure estimates and risk calculation in the following Step 2.

5.3.1.1 Screening Level Problem Formulation

For the screening-level problem formulation, a conceptual site model will be developed that addresses the five issues outlined below:

- **Environmental Setting and Contaminants at the Site.** An overall characterization of the environmental setting and chemical contamination will be developed from existing site reports, as well as from a completed site environmental checklist. Information will include onsite and offsite land uses, detected contaminants at the site, potential contaminant migration pathways, a description of natural or man-made ecological habitats (e.g., wetlands, impoundments), a description of observed or potentially occurring plant and animal species, and identification of any protected species or critical habitats.

- **Contaminant Fate and Transport.** Potential pathways for migration of site contaminants will be identified (e.g., surface water runoff and soil erosion). A list of detected contaminants in surface soil, surface water, and/or sediment will be identified, along with the maximum detected concentrations that will be used as ecological exposure point concentrations (EPCs) in the screening assessment.

- **Complete Exposure Pathways.** An evaluation of potential ecological exposure pathways will be conducted. For a pathway to be complete, a contaminant must travel from the source media to an ecological receptor, and be taken up by the receptor by one or more exposure routes. Although ecological habitats are minimal in most portions of NASD, a conservative approach will be used in this screening evaluation so that potential ecological risks are not missed. More realistic exposure assumptions will be considered later in Step 3, if needed.

- **Assessment and Measurement Endpoints.** Assessment endpoints, which are expressions of the environmental values to be protected, will be developed based on those ecological exposure pathways considered potentially complete. Measurement endpoints are measurable ecological characteristics of the assessment endpoint. In this screening-level evaluation, the measurement endpoint will be the comparison of maximum EPCs to conservative screening level benchmarks.

5.3.1.2 Screening-Level Ecological Effects Evaluation

In this section, conservative thresholds for adverse ecological effects, or screening ecotoxicity values, will be presented for contaminants detected in each of the site media (surface water, sediment, and surface soil). These values will be as follows:

- **Surface Water.** The surface water ecotoxicity screening values will be chronic values obtained from USEPA *National Recommended Water Quality Criteria* (USEPA, 2002). Whether freshwater or marine surface water criteria will be used will depend on the measured salinity of the surface water at each site, if present.

- **Sediment.** The sediment ecotoxicity screening values will be obtained from NOAA *Effects Range-Low (ERL)* values.

- **Soil.** The soil ecotoxicity values will be obtained from USEPA Region 4, Draft Ecological Screening Levels for Soil from "Memorandum – Ecological Risk Assessment at Military Bases: Process Considerations, Timing of Activities, and Inclusion of Stakeholders", December 22, 1998.

5.3.2 Step 2 - Screening Level Exposure Estimate and Risk Calculation

This step includes estimating exposure levels and screening for ecological risks as the last two phases of the screening level ERA. At the end of Step 2, a scientific management decision point (SMDP) will be made to determine if ecological risks are negligible or if further evaluation is warranted.

5.3.2.1 Screening Level Exposure Estimates

The maximum detected concentration of all chemicals detected in surface water, sediment, or soil will be used as the EPC for estimating risk to selected receptors chosen to represent the assessment endpoints, which may include fish, aquatic invertebrates, and directly exposed terrestrial organisms. Exposures for upper trophic level receptors species via food web will be determined by estimating the chemical specific concentrations in each dietary component using uptake and food web models. Maximum measured media concentration will be used as exposure point concentrations for exposure estimation and food web modeling.

5.3.2.2 Screening Level Risk Calculation

The quantitative screening-level risk estimate will be conducted using the Hazard Quotient (HQ) approach. This approach divides the EPCs with the screening ecotoxicity values. An HQ less than one indicates that the contaminant is unlikely to cause adverse effects, therefore these contaminants will not be assessed further. Contaminants with an HQ greater than or equal to one will be considered a potential ecological risk and will be carried forward as COPC to Step 3, as will contaminants that do not have ecotoxicity screening criteria.

5.3.2.3 Uncertainty Assessment

Uncertainty is inherent in each step of the screening level ecological risk assessment. Professional judgment will be used to determine the uncertainty associated with information taken from the literature and any extrapolations used in developing screening ecotoxicity values.

5.3.2.4 Scientific Management Decision Point (SMDP)

At the end of Step 2, a decision is made on whether the information available is adequate to make a risk management decision. The three possible decisions at this point include the following:

- There is adequate information to conclude that ecological risks are negligible and therefore no need for remediation on the basis of ecological risk.
- The information is not adequate to make a decision at this point, and the ERA process will continue to Step 3.
- The information indicates a potential for adverse ecological effects, and a more thorough assessment is warranted.

5.3.3 Step 3 - Baseline Risk Assessment Problem Formulation

Step 3 refines the problem formulation developed in the screening level assessment. In this step, the results of the screening level assessment and additional site-specific information are used to determine the scope and goals of the baseline ERA.

5.3.3.1 Refinement of Preliminary Constituents of Concern

Because of the conservative assumptions used during screening Steps 1 and 2, some COPC retained for Step 3 may still pose negligible risk. Therefore, in this first phase of Step 3 (commonly called Step 3a), further evaluation of the assumptions used and other site-specific information are considered to refine the COPC. For example, those contaminants for which the HQs drop to near or below one, the risk management team may agree to eliminate those from further consideration.

In this Step 3a refinement phase, the revised assumptions and site-specific considerations to be used are as follows:

- Arithmetic average contaminant exposure concentrations will be considered along with maximum exposure concentrations.
- Contaminant concentrations will be compared to background.
- Frequency of detection will be considered.
- Acute, low observed adverse effect levels (LOAEL), or other less conservative ecotoxicity screening values will be considered from the various literature sources used by USEPA Region IV.
- Other literature sources of ecotoxicity screening values may be included where appropriate (e.g., if no ecotoxicity screening value was available in Step 2).

These additional considerations will be used to calculate a range of HQs as follows:

- Maximum versus chronic criterian observed adverse effect levels (NOAEL)
- Maximum versus acute criteria/LOAEL
- Average versus chronic criteria/NOAEL
- Average versus acute criteria/LOAEL

Maximum and average values will also be compared to background concentrations.

In addition, the conservative ecological exposure pathways used in Step 2 will be reevaluated based on actual site conditions. All this information will provide a weight-of-evidence to determine which, if any, contaminants should be recommended for further evaluation in a baseline ERA. If there are no constituents or exposure pathways of concern following the refinement process, a SMDP will be described indicating that ecological risks are negligible and, therefore, there is no need for remediation on the basis of ecological risk.

If contaminants of concern remain following the Step 3a refinement process, a further baseline risk evaluation needs to be completed within the remaining phase, Step 3b, as well as all of Steps 4 through 8.

5.3.4 Step 3b - Baseline Ecological Risk Assessment Problem Formulation

The baseline ERA problem formulation is a revision of the screening problem formulation and is focused on better defining the important issues regarding the potential risk. This revised problem formulation consists of a reevaluation of the toxicity of key COPC, and a refined conceptual model. The conceptual model includes a discussion of exposure

pathways, assessment endpoints, and risk hypothesis questions. It serves as a basis for development of necessary site-specific studies (Step 4) if they are needed. Steps 4 through 8, which compose a full baseline ERA, are briefly described below. The SMDPs occur at the conclusion of each of these steps, and may allow the baseline ERA process to end at any of these points.

5.3.5 Step 4 - Study Design and Data Quality Objectives Process

The study design seeks to prove or refute the hypotheses in the ERA conceptual site model developed in Step 3. Depending on the findings and conclusions in the SMDP in Steps 2 and 3, the project team may discuss the need to develop this step. The study design should provide all procedures used for sampling and all methods, models or techniques used for data analysis. A DQO process should be followed to set limits on decision errors and to obtain samples most likely to pose answers posed in the Problem Formulation. An SMDP occurs at this stage for stakeholders to provide input to and approve the study design.

5.3.6 Step 5 - Verification of Field Sampling Design

Verification confirms that the proposed data collection is possible and feasible in the field, and ensures that the work plan and various sampling plans will meet the needs of the Problem Formulation.

5.3.7 Step 6 - Site Investigation

The site investigation is the actual performance of the data collection. Deviations from the approved plans of study require agreement among the stakeholders.

5.3.8 Step 7 - Risk Characterization

The data collected in Step 6 is analyzed using the methods developed in Step 4.

5.3.9 Step 8 – Risk Management

The final process is Risk Management. Risk management includes the selection of a preferred remedial alternative amongst several alternatives, and will involve discussions with all stakeholders.

5.4 Remedial Goal Options (RGOs)

The remedial goal options (RGOs) will be estimated for the pathway and the receptor that is identified to have excessive risks. Media with risks and HIs below the acceptable levels will not be further evaluated in this section. An RGO will be estimated for media presenting excess risk (e.g., $>10^{-4}$) or an unacceptable HI (>1.0). A quantitative cleanup level will not be estimated for the media presenting low human health or ecological risks. Concentrations will be compared with available ARARs, and discussion of remedial options by media for each site will be provided.

5.4.1 ARARs and To Be Considered (TBC) Requirements

The existing ARARs and TBC requirements will be reviewed and modified, as necessary. ARARs and TBCs will be used to evaluate subsequent proposed remedial actions. Location-

specific ARARs and activity-specific ARARs will be developed. Applicability of the ARARs and TBCs for these RCRA sites will determined by site risk managers.

5.4.2 Risk Based RGOs

For sites presenting excess human health or ecological risk, remedial goal options will be developed as per USEPA Region IV guidance. A quantitative RGO will be calculated for those media and chemicals presenting excess cancer risk or HI above an acceptable risk range or HI value. Chemicals and media that represent low risks and HIs will not be included for an RGO estimation.

TABLE 5-1
Exposure Factors for Soil

Symbols	Parameter	Maintenance Worker		Utility Worker		Industrial Worker		Residential Adult		Residential Child		Recreational Child		Recreational Youth	
BW	Body Weight (kg)	70	a	70	a	70	a	70	a	15	a	15	a	45	a
IR_Inh	Inhalation Rate (m^3/day)	20	a	20	a	20	a	20	a	15	a	15	a	20	a
IR_Inh_adj	Age-adjusted Inhalation Rate (m^3-yr/kg-day)	N/A		N/A		N/A		12.86	a,o	N/A		N/A		N/A	
AT_C	Averaging Time – Carcinogenic	70x365	a	70x365	a	70x365	a	70x365	a	N/A	a	N/A	a	70x365	a
AT_NC	Averaging Time – Noncarcinogenic	25x365	a	25x365	a	25x365	a	30x365	a	6x365	a	6x365	a	10x365	a
	Soils														
IR_Ing	Incidental Ingestion Rate (mg/day)	50	b	100	b	50	b	100	b	200	b	200	b	100	b
IR_adj_Ing	Age-adjusted Incidental Ingestion Rate (mg-yr/kg-day)	N/A		N/A		N/A		114.29	b,p	N/A		N/A		N/A	
FI	Fraction Ingested	0.5	c	0.5	c	1	c	1	c	1	c	1	c	1	c
SA	Skin Surface Area (cm^2)	2,679	d	2,679	d	2,679	d	5,049	e	2,351	f	2,351	f	4,478	f
SA_adj	Age-adjusted Skin Surface Area (cm^2-yr/kg)	N/A		N/A		N/A		2,671	e,q	N/A		N/A		N/A	
AF	Adherence Factor for dry soil (mg/cm^2)	0.03	h	0.1	i	0.03	h	0.03	h	0.15	j	0.15	j	0.15	j
PEF	Particulate Emission Factor (m^3/kg)	1.32E+09	k	1.32E+09	k	1.32E+09	k	1.32E+09	k	1.32E+09	k	1.32E+09	k	1.32E+09	k
ET	Exposure Time (hours/day)	8	a	8	a	8	a	NA	l	NA	l	4	l	4	l
EF	Exposure Frequency (days/year)	50	m	24	n	250	a	350	a	350	a	50	b	45	b
ED	Exposure Duration (years)	25	a	25	a	25	a	30	a	6	a	6	a	10	a

Notes:
All current scenario exposure factors are subject to re-evaluation based on site-specific information

a Default exposure factors adapted from USEPA, Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors" OSWER Directive 9285.6-03, March 25, 1991.

b Adapted from USEPA Supplemental Guidance to RAGS: Region 4 Bulletins, Human Health Risk Assessment, Interim, November 1995.

c Fraction ingested assumed by the nature of the activity

d Worker soil exposure is adapted from USEPA Exposure Factor Handbook, August 1997 & is protective of 1/2 head (face), hands & forearms. (see Appendix G)

e Residential/recreational adult soil exposure is adapted from USEPA Exposure Factor Handbook, August 1997 & is protective of 1/2 head (face), hands, forearms & lower legs. (see Appendix G)

f Residential/recreational child soil exposure is adapted from USEPA Exposure Factor Handbook, August 1997 & is protective of 1/2 head (face), hands, forearms, lower legs & feet. (see Appendix G)

g Recreational youth soil exposure is adapted from USEPA Exposure Factor Handbook, August 1997 & is protective of 1/2 head (face), hands, forearms, lower legs & feet. (see Appendix G)

h 0.03 = Groundskeeper No.2 (exposure scenarios similar to urban horticulture center, campus grounds, arboretum) AFs chosen from Soil Loading calculations (see Appendix G)

i 0.1 = Construction Worker (heavy digging, exposure to mixed bare earth, concrete surfaces, dust & debris) AFs chosen from Soil Loading calculations (see Appendix G)

j 0.15 = Daycare Kids No.1b (indoor exposure to linoleum; outdoor exposure to grass, bare earth; no shoes) AFs chosen from Soil Loading calculations (see Appendix G)

k PEF adapted from USEPA 1996, Soil Screening Guidance: Technical Background Document

l 4-hour soil exposure are assumed for residential dermal contact and inhalation exposure time.

m Worker soil exposure is assumed to be once a week per year, minus vacation time.

n Worker soil exposure is assumed to be twice a month.

o Age-adjusted inhalation rate for residential adult:

$$\text{IR-Inh adj} = \frac{\text{IR-Inhc} \times \text{EDc}}{\text{BWc}} + \frac{\text{IR-Inha} \times (\text{EDa} - \text{EDc})}{\text{Bwa}} = \frac{15 \times 6}{15} + 12.86 \quad \textit{(m3-year)/(kg-day)}$$

p Age-adjusted ingestion rate for residential adult:

$$\text{IRadj} = \frac{\text{IRc} \times \text{EDc}}{\text{BWc}} + \frac{\text{IRa} \times (\text{EDa} - \text{EDc})}{\text{Bwa}} = \frac{200 \times 6}{15} + 114.29 \quad \textit{(mg-year)/(kg-day)}$$

q Age-adjusted dermal contact for residential adult:

$$\text{SAadj} = \frac{\text{SAc} \times \text{EDc}}{\text{BWc}} + \frac{\text{SAa} \times (\text{EDa} - \text{EDc})}{\text{Bwa}} = \frac{2351 \times 6}{15} + 2671 \quad \textit{(cm2-year)/(kg)}$$

cm^2	Centimeters squared
days/year	days per year
hours/day	Hours per day
kg	Kilograms
m^3/day	cubic meters per day
m^3/kg	cubic meters per kilogram
mg/cm^2	Milligrams per centimeters squared
mg/day	Milligrams per day
N/A	Not applicable for this receptor

TABLE 5-2
Exposure Factors for Sediment and Surface Water

Symbols	Parameter	Maintenance Worker		Industrial Worker		Onsite Recreational Adult		Onsite Recreational Child		Onsite Recreational Youth	
BW	Body Weight (kg)	70	A	70	a	70	a	15	a	45	a
IR_Inh	Inhalation Rate (m^3/day)	20	A	20	a	20	a	15	a	20	a
AT_C	Averaging Time – Carcinogenic	70x365	A	70x365	a	70x365	a	N/A		70x365	a
AT_NC	Averaging Time – Noncarcinogenic	25x365	A	25x365	a	30x365	a	6x365	a	10x365	a
	Surface Water										
IR_Ing_w	Incidental Ingestion - Wading (L/hour)	0.01	B	0.01	b	0.01	b	0.01	b	0.01	b
SA_w	Skin Surface Area - Wading (cm^2)	2,679	C	2,679	c	5,671	d	1,851	e	4,785	f
ET	Exposure Time (hours/day)	2	G	2	g	2	g	2	g	2	g
EF	Exposure Frequency (days/year)	12	H	50	i	45	j	45	j	45	j
ED	Exposure Duration (years)	25	A	25	a	30	a	6	a	10	j
	Sediments										
IR_Ing	Incidental Ingestion - Wading (mg/day)	50	K	50	k	100	k	200	k	100	k
FI	Fraction Ingested	1	L	1	l	1	l	1	l	1	l
SA	Skin Surface Area - Wading (cm^2)	2,679	C	2,679	c	5,671	d	1,851	e	4,785	f
AF	Adherence Factor for wet soil (mg/cm^2)	0.1	M	0.1	m	0.1	m	0.1	m	0.1	m
ET	Exposure Time (hours/day)	2	G	2	g	2	g	4	g	4	g
EF	Exposure Frequency (days/year)	12	H	50	i	45	j	50	j	50	j
ED	Exposure Duration (years)	25	A	25	a	30	a	6	a	10	j

Notes:
All current scenario exposure factors are subject to re-evaluation based on site-specific information

a Default exposure factors adapted from USEPA, Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors" OSWER Directive 9285.6-03, March 25, 1991.

b Surface water ingestion while wading adapted from Supplemental Guidance to RAGS: Region 4 Bulletins, Human Health Risk Assessment, Interim, November 1995.

c Worker surface water/sediment exposure is adapted from USEPA Exposure Factor Handbook, August 1997 & is protective of 1/2 head (face), hands & forearms. (see Appendix G)

d Recreational adult sediment/surface water exposure is adapted from USEPA Exposure Factor Handbook, August 1997 & is protective of hands, forearms, lower legs, and feet. (see Appendix G)

e Recreational youth sediment/surface water exposure is adapted from USEPA Exposure Factor Handbook, August 1997 &is protective of hands, forearms, lower legs, and feet. (see Appendix G)

f Recreational child sediment/surface water exposure is adapted from USEPA Exposure Factor Handbook, August 1997 & is protective of hands, forearms, lower legs, and feet. (see Appendix G)

g 2 hours exposure to drainage ditch sediment/surface water is assumed for workers/recreational visitors based on the nature of the activities.

h Maintenance Worker surface water/sediment exposure is assumed to be once a month.

i Industrial Worker surface water & sediment exposure is assumed to be once a week.

j Recreational factors adapted from Supplemental Guidance to RAGS: Region 4 Bulletins, Human Health Risk Assessment, Interim, November 1995.

k Sediment ingestion rates adapted from Supplemental Guidance to RAGS: Region 4 Bulletins, Human Health Risk Assessment, Interim, November 1995.

l Fraction ingested assumed by the nature of the activity

m 0.1 = Construction Worker (heavy digging, exposure to mixed bare earth, concrete surfaces, dust & debris) AFs chosen from Soil Loading calculations (see Appendix G)

cm^2 Centimeters squared
days/year days per year
hours/day hours per day
kg Kilograms
L/hour liters per hour
m^3/day cubic meters per day
m^3/kg cubic meters per kilogram
mg/cm^2 Milligrams per centimeters squared
mg/day Milligrams per day
N/A Not applicable for this receptor

TABLE 5-3
Exposure Factors for Groundwater

Symbols	Parameter	Industrial Worker		Residential Adult		Residential Child	
BW	Body Weight (kg)	70	a	70	a	15	a
IR_Inh	Inhalation Rate (m^3/day)	*		*		*	
AT_C	Averaging Time – Carcinogenic	70x365	a	70x365	a	N/A	
AT_NC	Averaging Time – Noncarcinogenic	25x365	a	30x365	a	6x365	a
	Groundwater						
IR_Ing	Ingestion Rate of Water (L/day)	1	a	2	a	1	a
IR_adj_Ing	Age-adjusted Incidental Ingestion Rate (L-yr/kg-day)	N/A		1.1	a,f	N/A	
SA	Skin Surface Area (cm^2)	2679	b	20,000	c	6,557	d
SA_adj	Age-adjusted Skin Surface Area (cm^2-yr/kg)	N/A		9480	c,g	N/A	
ET	Exposure Time (hours/day)	0.007	e	0.007	e	0.007	e
EF	Exposure Frequency (days/year)	250	a	350	a	350	a
ED	Exposure Duration (years)	25	a	30	a	6	a

Notes:

* Inhalation exposures to volatiles in the groundwater are equal to the ingestion exposures as per USEPA Region IV policy

a Default exposure factors adapted from USEPA, Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors" OSWER Directive 9285.6-03, March 25, 1991.

b Worker groundwater exposure is adapted from USEPA Exposure Factor Handbook, August 1997 & is protective of 1/2 head (face), hands & forearms. (see Appendix G)

c Residential adult total body surface area is adapted from USEPA Exposure Factor Handbook, August 1997 & is protective of all body parts. (see Appendix G)

d Residential child total body surface area is adapted from USEPA Exposure Factor Handbook, August 1997 & is protective of all body parts. (see Appendix G)

e Calculation for Shower dermal exposure time: 10 minute event x 1 hour/60 minutes x 1 day/ 24 hours = 0.007 event/day

f Age-adjusted ingestion rate for residential adult:

$$IRadj = \frac{IRc \times EDc}{BWc} + \frac{IRa \times (EDa - EDc)}{Bwa} = \frac{1 \times 6}{15} + \frac{2 \times (30-6)}{70} = 1.1 \quad (L\text{-year})/(kg\text{-day})$$

g Age-adjusted dermal contact for residential adult:

$$SAadj = \frac{SAc \times EDc}{BWc} + \frac{SAa \times (EDa - EDc)}{Bwa} = \frac{6557 \times 6}{15} + \frac{20000 \times (30-6)}{70} = 9480 \quad (cm^2\text{-year})/(kg)$$

cm^2	Centimeters squared
days/year	Days per year
hours/day	Hours per day
kg	Kilograms
L/day	Liters per day
m^3/day	Cubic meters per day
N/A	Not applicable for this receptor

SECTION 6

Identification of Remedial Action Alternatives

The RAO and goals will be developed to assist in identifying remedial action alternatives, if necessary at the end of RI. The potential RAO for NASD is as follows:

- Provide adequate protection to human health and the environment from direct contact, ingestion, or inhalation of the hazardous constituents in soil, groundwater, surface water, and sediment beneath the site.

Institutional controls (ICs) were put in place on the site, which restrict construction activities that require excavation, and restrict the groundwater at the site from use as a future drinking water source. These deed restrictions (Site Management Plan, CH2M HILL, July 2001) ICs adequately protect human health and the environment from direct contact, ingestion, and inhalation of the contaminants present at the site, but the ICs limit future uses of the site until the site is remediated. Therefore, the goals of the remedial action alternative that will be developed during the detailed analysis stage include:

- Implementation of a site remediation approach that will reduce the contaminant mass and residual soil contamination present at each site
- Restoration of groundwater or surface soil to beneficial uses within a reasonable timeframe, given the particular circumstances of each site
- Consideration of innovative technologies when such technologies offer potential for superior treatment performance or lower costs for performance similar to that of presumptive remedies.

Remedial alternatives will be developed for soil and groundwater cleanup at each site within the FS, based on the RAO and goals. Each alternative will be evaluated against the nine criteria outlined in CERCLA, which include:

- Overall protection of human health and the environment
- Compliance with ARARs
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume
- Short-term effectiveness
- Implementability
- Cost
- State/support agency acceptance
- Community acceptance

Details of each of these criteria will be evaluated and included in a report for the specific sites and media identified to need remedial actions at the end of the RI, if unacceptable human health or ecological risks are identified.

SECTION 7

Remedial Investigation/Feasibility Study Report

A draft RI/FS Report will be prepared for submittal to LANTDIV, NSRR, USEPA, and PREQB in accordance with USEPA guidance. Based on the review comments on the Draft RI and FS Reports, Final Reports will be prepared. An outline of the RI and FS Reports excerpted from the RI/FS guidance (USEPA, 1988) is presented below.

Remedial Investigation Report

Executive Summary

1. Introduction
   - 1.1 Purpose of Report
   - 1.2 Site Background
     - 1.2.1 Site Description
     - 1.2.2 Site History
     - 1.2.3 Previous Investigations
     - 1.2.4 Physical Characteristics of Study Area
   - 1.3 Report Organization

2. Field Activities
   - 2.1 Decontamination of Sampling Equipment
   - 2.2 Monitoring Well Installation
   - 2.3 Monitoring Well Development
   - 2.4 Monitoring Well Purging and Sampling
   - 2.5 Groundwater Elevation Measurements
   - 2.6 Subsurface Soil Sampling
   - 2.7 Aquifer Performance Testing
   - 2.8 Surveying
   - 2.9 Laboratory Field Sampling Protocol

3. Nature and Extent of Contamination
   - 3.1 Risk-Based Criteria Screening Procedure
   - 3.2 Soils
   - 3.3 Groundwater

4. Contaminant Fate and Transport
   - 4.1 Potential Routes of Migration
   - 4.2 Contaminant Persistence
   - 4.3 Contaminant Migration

5. Baseline Risk Assessment
   - 5.1 Human Health Evaluation

- 5.1.1 Exposure Assessment
- 5.1.2 Toxicity Assessment
- 5.1.3 Risk Characterization
- 5.2 Ecological Risk Characterization
- 5.3 Environmental Evaluation

6. Conclusions and Recommendations

Feasibility Study Report

7. Identification of Screening Technologies
   - 7.1 Remedial Action Objectives
   - 7.2 General Response Actions
   - 7.3 Identification of Screening Technology Types and Process Options
     - 7.3.1 Identification of Screening Technologies
     - 7.3.2 Evaluation of Technologies and Selection of Representative Technologies

8. Development and Screening of Alternatives
   - 8.1 Development of Alternatives
   - 8.2 Screening of Alternatives
     - 8.2.1 Alternative 1
       - 8.2.1.1 Description
       - 8.2.1.2 Evaluation
     - 8.2.2 Alternative 2
       - 8.2.2.1 Description
       - 8.2.2.2 Evaluation
     - 8.2.3 Alternative 3 (etc.)

9. Detailed Analysis of Alternatives
   - 9.1 Introduction
   - 9.2 Individual Analysis of Alternatives
     - 9.2.1 Alternative 1
       - 9.2.1.1 Description
       - 9.2.1.2 Evaluation
     - 9.2.2 Alternative 2
       - 9.2.2.1 Description
       - 9.2.2.2 Evaluation
     - 9.2.3 Alternative 3 (etc.)

10. Conclusions and Recommendations

11. References

SECTION 8

Project Schedule

Table 8-1 presents the proposed project schedule for the RI/FS at the sites of the former NASD.

TABLE 8-1
Project Schedule, NASD RI/FS
Former NASD, Vieques, Puerto Rico

Task	Start Date	End Date
Draft Work Plan	10/01/02	2/24/03
Regulatory Review	2/24/03	3/31/03
Final Work Plan	4/1/03	7/25/03
Field Work (Additional Characterization)	8/11/03	9/05/03
Laboratory Analysis	905/03	10/05/03
Data Validation	10/05/03	11/05/03
Draft RI/FS Report	11/05/03	01/01/04
Regulatory Review	1/01/04	3/01/04
Respond to Comments	03/01/04	04/01/04
Final RI/FS Report	04/01/04	04/15/04
ROD	04/15/04	06/01/04
ROD Public Review	06/01/04	08/01/04
Remedial Design	08/01/04	11/01/04
Remedial Action Initiation	11/01/04	11/01/04

SECTION 9

Project Management

The CH2M HILL Project Manager designated for the oversight of this project is Mr. Marty Clasen. Mr. Clasen will be supported by Mr. John Tomik, who serves as Activity Manager for Vieques Island. Mr. Clasen will be assisted by Mr. Rick Gorsira and Dr. Vijaya Mylavarapu in the everyday management of this project. The RI/FS program (soil, groundwater, sediment and surface water sampling) will be performed by qualified CH2M HILL staff members. CH2M HILL will notify LANTDIV and NSRR as to which CH2M HILL personnel will mobilize to the site prior to initiating field activities. The Geophysical surveys and MEC Avoidance surveys will be conducted by subcontractors under the supervision of CH2M HILL.

The Navy Technical Representative (NTR) is Mr. Chris Penny. Mr. Penny is the LANTDIV representative, and provides technical direction on the project. He also coordinates funding and overall interaction with other agencies and interested parties. Mr. Penny can be contacted at the address and phone number listed below.

Mrs. Madeline Rivera Ruiz is the Installation Restoration (IR) Program Coordinator for NSRR. Mrs. Rivera is responsible for the coordination of all Naval environmental activities at NSRR and Vieques Island. Mrs. Rivera can be contacted at the address and phone number listed below.

Mr. Chris Penny
Remedial Project Manager
Installation Restoration Section
Environmental Programs Branch
Environmental Division
Atlantic Division (LANTDIV) Code 1822
Naval Facilities Engineering Command
1510 Gilbert Street
Norfolk, VA 23511-2699
(757) 322-4815

Mrs. Madeline Rivera Ruiz
U.S. Naval Station Roosevelt Roads
Environmental Engineering Division
Public Works Department, Bldg. 31
Ceiba, Puerto Rico 00735
(787) 865-5337

SECTION 10

References

American Water Works Association. *Water Quality & Treatment: A Handbook of Community Water Supply.* 5th Ed. 1999.

Applied Research Associates (ARA), personal communication August 2, 2002.

ARS Technologies. http://www.arstechnologies.com/. 2002.

AWWA, *Water Quality & Treatment: A Handbook of Community Water Supply.* 5th Ed. American Water Works Association. 1999.

Baker Environmental, Inc. *Final Preliminary Assessment Narrative Report Site Inspection Forms and LA Score, Sites 1, 2 and 3, US Naval Station, Roosevelt Roads, Puerto Rico.* October 1992.

Baker Environmental, Inc. *Results of the Hydrogeologic Investigation, Vieques, Puerto Rico.* November 4,1999.

Baker Inc. *Positive Detection in Site, Environmental, Summary Groundwater, Vieques, Puerto Rico.* November 15,1999.

Blasland, Bouck & Lee, Inc., *Site Characterization Report – Site 735 – Roosevelt Roads Naval Station, Ceiba, Puerto Rico.* November 1994.

Blasland, Bouck & Lee, Inc., *Site Characterization Report – Site 1995 – Roosevelt Roads Naval Station, Ceiba, Puerto Rico.* June 1995.

Bouwer and Rice, 1976. *A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells.* Water Resources Research, V12, pp. 423-428.

Briggs, Reginald P. & Aguilar-Cortez, Eduardo. Geologic Map of the Fajardo and Cayo Icacos Quadrangles, Puerto Rico, USGS Investigation Series, Map I-1153, 1980.

Center for Public Environmental Oversight. http://www.cpeo.org/. June 2002.

CH2M HILL, Inc. *Expanded Preliminary Assessment/Site Investigation, Phase II Seven Sites.* November 2002.

CH2M HILL, Inc. *Final Soil, Groundwater, Surface Water, and Sediment Background Investigation Report for NASD.* CH2M HILL, October 2002.

CH2M HILL, Inc. *Master Work Plan for the Former U.S. Naval Ammunition Support Detachment,* Vieques, Puerto Rico. January 2001.

CH2M HILL, Inc. *Phase I Final - Expanded Preliminary Assessment/Site Investigation, U.S. Naval Ammunition Support Detachment,* Vieques, Puerto Rico. October 2000.

CH2M HILL, Inc. *Investigation-Derived Waste Management Plan for the U.S. Naval Ammunition Support Detachment.* Vieques, Puerto Rico. May 2000.

CH2M HILL, Inc. *Master Work Plan for the U.S. Naval Ammunition Support Detachment,* Vieques, Puerto Rico. May 2000.

CH2M HILL, Inc. *Site-Specific Work Plan for the U.S. Naval Ammunition Support Detachment,* Vieques, Puerto Rico. April 2000.

CH2M HILL, Inc. *Expanded Preliminary Assessment/Site Investigation Field Investigation for SWMU 7.* April 2000.

CH2M HILL, Inc. *Site Characterization Report, Site 2016, U.S. Naval Ammunition Support Detachment, Vieques, Puerto Rico.* April 1999.

Environment Canada. *Interim Sediment Quality Guidelines.* Soil and Sediment Quality Section Guidelines Division, Ecosystem Conservation Directorate, Evaluation and Interpretation Branch, Ottawa, Ontario. September 1995.

Environmental Resources Management Group. *Environmental Baseline Survey.* June 2000.

ESE. *Confirmation Study to Determine Possible Dispersion and Migration of Specific Chemicals - US Naval Station, Roosevelt Roads, Puerto Rico and US Naval Ammunition Facility, Vieques: Evaluation of Data from First and Second Rounds of Verification Sample Collection and Analysis.* May 1986.

Geo-Marine, Inc. *Ecological Survey.* August 2000.

IAS. Greenleaf/Telesca Planners, Engineers, Architects, Inc. and Ecology and Environment, Inc. *Initial Assessment Study, Naval Station Roosevelt Roads, Puerto Rico.* September 1984.

M'Gongile, J.W., Geologic Map of Naguabo and Part of the Punta Puerca Quadrangle, Puerto Rico, USGS Miscellaneous Investigation Series, Map I-1099, 1979.

MHSPE (Ministry of Housing, Spatial Planning, and Environment). 9 May 1994. *Intervention Values and Target Values - Soil Quality Standards.* Directorate-General for Environmental Protection, Department of Soil Protection, The Hague, The Netherlands.

Puerto Rico Environmental Quality Board (PREQB). *Puerto Rico's Underground Storage Tank Control Regulations,* As Amended November 7, 1990.

Puerto Rico Environmental Quality Board (PREQB). *Puerto Rico's Water Quality Standards Regulations.* February 2002

Raffaele, H., J. Wiley, O. Garrido, A. Keith, and J. Raffaele. *A Guide to Birds of the West Indies.* Princeton University Press, Princeton, N.J. 1998.

Raffaele, H.A. *A Guide to the Birds of Puerto Rico and the Virgin Islands.* Princeton University Press, Princeton, N.J. 1989.

Region IX Preliminary Remedial Goals – *Industrial Soil Values,* November 22, 2000.

Region IX Preliminary Remedial Goals – *Residential Soil Values,* November 22, 2000.

Region IX *Soil Screening Level, Migration to Ground Water – Dilution Attenuation Factor* (DAF) 20, November 22, 2000.

RFA. A.T. Kearney, Inc. and K.W. Brown & Associates, Inc. *Phase II RCRA Facility Assessment of the Naval Ammunition Facility, Vieques Island, Puerto Rico.* October 1988.

Selective Adsorption Associates (SAA). http://selectiveadsorption.com. Personal communication. August 7, 2002.

U.S. Environmental Protection Agency USEPA. *Technology Status Report: Treatment Walls,* EPA 542-K-94-004, April, 1995.

U.S. Environmental Protection Agency USEPA. *Contract Laboratory Program Functional Guidelines for Organic Data Review.* February 1994.

U.S. Environmental Protection Agency USEPA. *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA.* Interim Final. October 1988.

U.S. Environmental Protection Agency USEPA. *Maximum Contaminant Level, Drinking Water Standards and Health Advisories.* 2000.

U.S. Environmental Protection Agency. *Contract Laboratory Program National Functional Guidelines for Organic Data Review.* October 1999.

U.S. Environmental Protection Agency. *Ecological Risk Assessment Guidance for Superfund, Process for Designing and Conducting Ecological Risk Assessments.* Interim Final. EPA 540-R-97-006. June 5, 1997

U.S. Environmental Protection Agency. *Ecological Screening Values. In: Supplemental Guidance to RAGS: Region 4 Bulletins-Ecological Risk Assessment,* Bull. No.2, Atlanta, Georgia. November 1995.

U.S. Environmental Protection Agency. *Ecological Soil Water Criteria: EPA Amended Guidance on Ecological Risk Assessments at Military Bases: Process Considerations, Timing of Activities, and Inclusion of Stakeholders.,* Region IV Office of Technical Services, December 10, 1998

U.S. Environmental Protection Agency. *Ecotox Thresholds, ECO Update,* Office of Solid Waste and Emergency Response, Intermittent Bulletin Vol. 3, No. 2, Publication 9345.0- 12FSI, EPA 540/F-95-038 PB95-963324. January 1996.

U.S. Environmental Protection Agency. *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA.* Interim Final. October 1988.

U.S. Environmental Protection Agency. *In Situ Remediation.* Technology Status Report: *Treatment Walls,* EPA 542-K-94-004, April, 1995.

U.S. Environmental Protection Agency. *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review.* 2002.

U.S. Environmental Protection Agency. *Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses.* 1994.

U.S. Environmental Protection Agency. *Land Use in the CERCLA Remedy Selection Process. (OSWER Directive: 9355.7-04). 1992.*

U.S. Environmental Protection Agency. Region IV *Supplemental Guidance to RAGS*: Region 4 Bulletins, Freshwater Surface Water Screening Values for Hazardous Waste Sites (EPA, 1995).

U.S. Environmental Protection Agency. Region IV. *Draft Ecological Screening Levels for Soil.* Ecological Risk Assessment at Military Bases: Process Considerations, Timing of Activities, and Inclusion of Stakeholders. December 22, 1998.

U.S. Environmental Protection Agency. Region IX *Preliminary Remedial Goals* – Residential Soil Values, November 22, 2000

U.S. Environmental Protection Agency. Region IX PRGs - *Tap Water Values.* November 22, 2000.

U.S. Environmental Protection Agency. Region IX Soil *Screening Level, Migration to Ground Water – Dilution Attenuation Factor* (DAF) 20, November 22, 2000.

U.S. Geological Survey. Water Resources Investigation, Reconnaissance of the Groundwater Resources of Vieques Island, Puerto Rico. Report 86-4100 (by Sigfredo Torres-Gonzalez). 1989.

Statement of Work for Ordnance Explosives (OE) Support Services at NASD, SWMUs 6 and 7, AOC J, Vieques Island, Puerto Rico

Introduction

CH2M HILL is under contract to conduct four RI/FS activities in Area of Concern (AOC) J (Former Staging and Disposal Site), Solid Waste Management Unit (SWMU) 6 (Mangrove Disposal Site), and SWMU 7 (Quebrada Disposal Site) at the Naval Ammunition Supply Detachment (NASD), Vieques Island, Puerto Rico to provide data needed in support of these Remedial Investigation / Feasibility Study activities.

The OE firm (hereinafter referred to as the "subcontractor" will support CH2M HILL's brush clearing (AOC J) and sampling efforts for this project by providing on-site OE support during all field activities, which will include brush clearing, electromagnetic surveys (EM), surface and subsurface soil sampling, subsurface drilling, surveying of the sampling points/wells, and access to these areas. The OE team will not remove, handle, or destroy any OE/UXO that is encountered. The subcontractor will comply with the health and safety requirements specified by CH2M HILL's Health & Safety Plan, at a minimum, as well as any H&S Procedures that are specified to the subcontractor's specialized services; these will be included in the subcontractor's UXO work plan described below.

Site Descriptions

SWMU 6 – Mangrove Disposal Site

The Mangrove Disposal Site is located in a 1-acre ocean-side mangrove swamp in Laguna Arenas along North Shore Road (Route 200) on the Former NASD. The site was used during the 1960s and 1970s as a base disposal area. The site was abandoned and the vegetation consisting of mostly red and black mangrove has taken over the area.

Waste materials extend approximately 100 to 120 feet north-northeast of the North Shore Road from the east side of the Laguna Kiani Bridge. Trash disposed of at this site included cans of lubricants and oil, solvents, paints, and rubble. A CH2M HILL inspection in conjunction with a UXO team (May 2000) also identified ordnance items such as concrete-filled practice bombs and solid waste from the base galley such as pieces of broken glass and china. An IAS team (1984) had estimated that this site contains approximately 800 cubic yards of material.

SWMU 7 – Quebrada Disposal Site

The Quebrada Disposal Site encompasses an area of approximately 1 acre and is located west of a dirt access road that heads south from State Road 200. The landfill site was used

between the early 1960s and late 1970s. The vegetation has taken over and has made it difficult to keep the site clear for investigation purposes.

The steep ravine varies from 20 to 30 feet wide and has 10 to 20 feet deep embankments. The solid waste was discarded into the ravine by pushing it over the embankment. More that 1,500 cubic yards of material are estimated to be present at the site (IAS, 1984).

AOC H – Power Plant

AOC H is an abandoned concrete building that operated as a power plant for a period of 3 years prior to Navy activities (1941 to 1943). The building formerly stored power generation equipment and large diesel generators to provide electricity to a nearby community. Aboveground storage tanks (ASTs) associated with the generators were located on the west side of the building, and provided an estimated 2,000 to 3,000 gallons of diesel fuel storage.

After 1943, the building was vacant until the 1960s when it was used for fire-training operations. Diesel fuel was ignited over rubber tires inside the building to simulate structure fires. The fire training activities ceased in the 1980s. The building has remained abandoned and is overgrown with vines and tall shrubs.

AOC J – Former Staging Area Disposal Site

AOC J encompasses an area of approximately 1.2 acres and was used from 1965 to 1973 as a solid waste dump site for construction staging activities. The site is located on a wooded area next to a tidally-influenced stream on the north coast of the Former NASD. After 1973, most of the waste was removed from the site and placed in a municipal landfill off-base. No records were kept as to where the unidentified solid waste was taken.

In May 2000, a CH2M HILL inspection with a UXO team identified several OE items, including 105 mm shell casings and empty ammunition boxes.

UXO Support Services Required

Subcontractor Tasks - Ordnance Explosives (OE) Avoidance

The subcontractor shall provide a two-person OE team to provide on-site OE avoidance support during all brush clearance, sampling activities, which include surface and subsurface soil sampling, surveying of sampling points and installation and sampling of monitoring wells. The subcontractor OE team will be comprised of a minimum of a UXO Technician III as Team Leader and a UXO Technician II as team member. The OE team will not remove, handle, or destroy any OE or unexploded ordnance (UXO) encountered. The OE team will report all OE/UXO to Eric Isern/CH2M HILL, who in turn will request assistance from the Roosevelt Roads Navy EOD Team, Senior Chief Jones point of contact, for proper removal and disposal.

The subcontractor OE Team will be comprised of a minimum of a UXO Technician III and a UXO Technician II. Resumes, medical surveillance, and OSHA 40 hour training certificates of the OE Team personnel must be provided to the CH2M HILL UXO Safety Officer prior to mobilization.

OE Team Composition and Qualifications.

- *UXO Team Leader.* This individual will be a UXO Technician III and will be the technical lead directly responsible for all OE avoidance activities at each project site. This person must have documented experience in supervising range clearance operations and supervising personnel. This individual must be a graduate of the U.S. Army Bomb Disposal School, Aberdeen Proving Ground, Maryland or the Naval Explosive Ordnance School at Indian Head, Maryland and have at least 10 years of combined military active duty EOD and contractor UXO experience.

- *UXO Team Member.* This individual must be a UXO Technician II and a graduate of the U.S. Army Bomb Disposal School, Aberdeen Proving Ground, Maryland U.S. Naval Explosive Ordnance School at Indian Head, Maryland. As an exception, a UXO Technician II may be an UXO Technician I that is a graduate of the EOD Assistants Course, Redstone Arsenal, Alabama, the EOD Assistants Course Eglin Air Force Base, Florida, or a DOD certified equivalent course with at least five years (combined) active-duty military EOD and contractor UXO experience.

Responsibilities and Authority. The OE team will provide the explosive ordnance recognition, location, and safety function for all contractor personnel on site. The OE Team Leader has final authority for on site personnel regarding all matters pertaining to OE/UXO.

Task 1 - Work and Safety Plans . The OE team will follow their approved OE Safety and Health Plan which is appended as Appendix D in CH2M HILL's Work Plan for these 4 RI/FS activities. The UXO Team Leader will conduct safety briefings for all site personnel and visitors.

Task 2 - Mobilization/Demobilization.

Upon notice to proceed, provide all necessary personnel and equipment to accomplish the scope of work.

Task 3 – OE Avoidance

Clear Access Routes to Sampling Locations.

a. Prior to brush clearing at AOC J (or any other of the 3 sites) the OE Team shall conduct a reconnaissance of the area to be cleared. Only after this area has been inspected and approved for further activities by the UXO Team Leader, shall movement into the area, drilling or sampling activities commence.

b. Prior to sampling or well drilling crews going on site, the OE Team shall conduct a reconnaissance of the sampling and drilling areas. The reconnaissance shall include

locating a clear path for the sampling crews, vehicles and equipment to approach the site. The approach path, at a minimum will be twice the width of the widest vehicle. The contractor will clearly mark all boundaries of the cleared approach path to prevent personnel from straying into un-cleared areas. No personnel shall be allowed outside the cleared paths.

c. If OE/UXO is encountered on the surface, divert the approach around the OE/UXO, clearly, mark the area and report the OE/UXO.

d. A magnetometer shall be used to insure there is no subsurface UXO within the approach paths. If an magnetic anomaly is encountered, assume it to be a UXO and divert the path around the anomaly. Only UXO personnel shall identify UXO and operate the magnetometer.

Soil Sampling/Well Installation Sites.

a. The OE team shall locate magnetic anomaly areas for soil samples and well drilling. If a pre-selected area indicates magnetic anomalies, a new sampling site will be chosen.

b. The Contractor will clearly mark the boundaries of the cleared soil sampling. Personnel will not go outside the cleared area. As a minimum, the cleared area will be a square, with a side dimension equal to twice the length of the largest vehicle or piece of equipment to be bought on site.

c. Prior to drilling equipment being moved to the proposed well location, the OE Team shall locate a magnetic anomaly free site. This shall be accomplished using a magnetometer with down-hole monitoring capabilities. The OE Team will direct the beginning of the borehole, which will be started with a hand held or portable auger. At not more than a two foot depth, the auger will be withdrawn and the magnetometer will be lowered into the borehole. This procedure will be used to insure that smaller items of UXO, undetectable from the surface, can be detected. If no magnetic anomalies are found, the procedure will be repeated at two foot intervals to the maximum depth of the auger, but not less than 4 feet. If the proposed borehole site is free of magnetic anomalies, the drilling equipment may be bought on site and utilized. Borehole monitoring with the magnetometer shall continue at two foot intervals, until the sampling is completed.

SAFETY and Quality Assurance

The subcontractor must provide the CH2M HILL UXO Safety Officer a current SAFETY EMR below industry averages to be eligible for this solicitation. The OA Health and Safety plan provided by the sub-contractor is appended as Appendix D.

The site is considered a hazardous waste site. Therefore, the subcontractor will comply with 29 CFR 1910.120, the OSHA regulations for the protection of hazardous waste workers. The subcontractor may refer to CH2M HILL's Health and Safety Plan for a description of site conditions at the project site, including safety of all personnel and property during performance of the work. Subcontractor personnel must be on a medical surveillance program and have current physicals.

Workmanship

The subcontractor will provide all necessary tools, support equipment, and ancillary materials needed to complete the work described herein. The subcontractor will perform all work necessary to move personnel and equipment in and out of the site, set up equipment, and restore the site to its original condition. To the extent possible, the site will be left in the condition in which it was found.

Task 4 - Report

The subcontractor shall prepare a final report that includes daily activities, UXO identified (complete description required: For example: 105mm HE Projectile with M51 Point Detonating Fuze, Fired and Fuze Armed), any problems, and lessons learned.

Deliverables/Schedule

TBD

Payment and Bid Requirements

Payment for successfully completed work will be stated in the subcontractor's attached Bid Form. Additional materials or equipment required to complete the work as specified, although not specifically addressed, will be included in the unit rates.

References

DOD 6055.9-STD	DOD Ammunition and Explosives Safety Standards
OPNAVINST 8020.14	Department of the Navy Explosives Safety Policy
NAVSEA OP 5 Vol 1	Ammunition and Explosives Ashore: Safety Regulations for Handling, Storing, Production, Renovation and Shipping
Interim Guidance Document 00-03	Basic Safety Concepts and Considerations for OE Operations, U.S. Army Corps of Engineers OE Center of Excellence

NAEVA GEOPHYSICS INC.
THE LEADER IN SUBSURFACE DETECTION
Subsurface Geophysical Surveys

GPR
MAGNETICS
ELECTROMAGNETICS
SEISMICS
RESISTIVITY
UTILITY LOCATION
UXO DETECTION
BOREHOLE CAMERA
STAFF SUPPORT

February 19, 2003

Technical Memorandum

SWMU 6 NASD
Vieques Island, Puerto Rico

NAEVA Geophysics was contracted by CH2M HILL to provide limited Global Positioning System (GPS) location surveys within the area known as SWMU 6 on the island of Vieques, Puerto Rico. The purpose of the survey was to map the surface expression of suspected waste piles within SWMU 6. Survey work was conducted on June 25, 2002 after which all data was forwarded to CH2M HILL technical personnel.

NAEVA utilized an Ashtech Z-FX Surveyor RTK GPS system for the acquisition of point locations. A GPS base station, utilizing an Ashtech Z-FX receiver, was used in conjunction with a rover antenna mounted atop an approximately two-meter long pole. Real time corrections were broadcast to the roving GPS unit via a radio link using Pacific Crest radio modems. This system provides positional updates at a rate of 1 Hz, with an accuracy of 3-cm horizontal. During data collection, data was stored in a Compaq Aero palm-top computer and later downloaded into a laptop computer.

CH2M HILL on-site personnel accompanying NAEVA's survey team identified suspected waste piles within SWMU 6. Survey point locations associated with linear features and large round features were designed to mark the outside edge of the surface expression. Smaller suspected waste piles were surveyed with a single point at the approximate center of the feature. Thick tree cover that degraded the GPS signal and prevented pedestrian access limited the data collection in certain areas. In addition, several of the piles appeared to extend below the present ground level, leaving no noticeable surface expression to map. NAEVA views this survey effort as a first approximation of the areas of most obvious visible waste contamination. Attached to this memorandum is a spreadsheet listing all GPS points and their coordinates.

MARYLAND
4707 Benson Ave.
Suite 104
Baltimore
Maryland 21227
(410) 536-7600
410) 536-7602 Fax

NEW YORK
0 N. Harrison Ave.
Suite 11
Congers
New York 10920
(845) 268-1800
845) 268-1802 Fax

VIRGINIA
P.O. Box 7325
Charlottesville
inia 22906
) 978-3187
434) 973-9791 Fax

AUTO_ID	WGS84_L(	WGS84_L/	WGS84_A	GPS_DATI	GPS_TIME	ID
1	-65.56148	18.11756	22.95	20625	150003	SWMU SIX
2	-65.56158	18.11767	22.49	20625	150247	
3	-65.56162	18.11777	22.68	20625	150436	
4	-65.56147	18.11779	22.44	20625	150707	
5	-65.56142	18.11786	22.33	20625	150804	
6	-65.56135	18.11782	22.41	20625	150859	
7	-65.56137	18.11771	22.38	20625	150931	
8	-65.56135	18.11765	22.64	20625	151008	
9	-65.56124	18.11769	22.58	20625	151411	
10	-65.56126	18.1177	22.62	20625	151427	
11	-65.56123	18.11771	22.67	20625	151445	
12	-65.56124	18.11772	22.59	20625	151500	
13	-65.56124	18.11775	22.62	20625	151524	
14	-65.56119	18.11775	22.66	20625	151549	
15	-65.56116	18.11776	22.45	20625	151616	
16	-65.56117	18.11778	22.54	20625	151641	
17	-65.56114	18.1178	22.45	20625	151711	
18	-65.5611	18.11781	22.43	20625	151755	
19	-65.56109	18.1178	22.35	20625	151813	
20	-65.56111	18.11779	22.49	20625	151836	
21	-65.56136	18.11764	22.49	20625	152330	
22	-65.56138	18.11765	22.39	20625	152346	
23	-65.56141	18.11763	22.43	20625	152443	
24	-65.5614	18.11761	22.46	20625	152456	
25	-65.56168	18.11774	22.83	20625	152856	
26	-65.56168	18.11771	22.96	20625	152911	
27	-65.5617	18.11769	23.23	20625	152934	
28	-65.56161	18.11767	22.53	20625	153039	
29	-65.56161	18.11768	22.56	20625	153053	
30	-65.5616	18.11768	22.57	20625	153110	
31	-65.56159	18.11767	22.53	20625	153143	
32	-65.5616	18.11765	22.52	20625	153154	
33	-65.5616	18.11764	22.53	20625	153214	
34	-65.5616	18.11764	22.52	20625	153231	
35	-65.56158	18.11764	22.45	20625	153246	
36	-65.56156	18.11765	22.46	20625	153302	
37	-65.56155	18.11767	22.5	20625	153322	
38	-65.56154	18.11764	22.52	20625	153421	
39	-65.56153	18.11766	22.47	20625	153442	
40	-65.56152	18.11764	22.48	20625	153504	
41	-65.5615	18.11764	22.44	20625	153514	
42	-65.5615	18.11765	22.44	20625	153528	
43	-65.56151	18.11766	22.48	20625	153543	

March 6, 2000 Revision
Laboratory Electronic Deliverable Format for CH2M HILL, version 4.00
Sources: Vito D'Aurora/RDD, Ed Svastits/GNV

Electronic Data Deliverable Format for CH2M HILL

The electronic data deliverable (EDD) file from the laboratory will be a comma-delimited ASCII (CDA) file in the format listed below. There will be one file per hard copy report and the filename of the EDD file will be in the format REPORTID.txt or REPORTID.csv, where REPORTID is the hard copy report identifier of sample delivery group.

The first row of the EDD will contain the 47 field name values as listed in the EDD Specification Table

The EDD Specification Table lists the attributes of the columns for each row of the CDA file. The fields should be reported in the order indicated.

The **Data Type** column describes the value in the field as either text (alphanumeric), number (numeric only), date (format: mm/dd/yyyy), or time (24-hour format hh:mm). If the field is conditional or optional and there is no value to be reported, report a null (i.e., no) value. For a text field, do not report a zero-length string (i.e., "").

The **Data Length** column contains the maximum length of a text value for the particular data field.

The **Rqmt** column contains a code indicating whether the value is required (R) for all rows, optional (O) for all rows, or conditional (C) and depends on the type of result reported.

March 6, 2000 Revision
Laboratory Electronic Deliverable Format for CH2M HILL, version 4.00
Sources: Vito D'Aurora/RDD, Ed Svastits/GNV

Modification Notes:

Changes to February 9, 2000 Revision:

1. Change the description of the QAQCType field (Field No. 6) to clarify how diluted samples should be reported.
2. Change the description of the LRType field (Field No. 7) to allow for multiple dilutions, re-analyses, and confirmation sample analyses. Also change the example values to reflect this change.
3. Change the description of the AnalysisMethod field (Field No. 10) to correct grammatical error.
4. Minor typographical/grammatical changes in the descriptions of the ExtractDate and ExtractTime fields (Field Nos. 15 and 16).
5. Change requirement of the LabLotCtlNum field (Field No. 20) from Required to Conditional. If there is no preparation, then the value in this field should be blank.
6. Change data type of the Result field (Field No. 24) from Number to Text, length of 10. Clarify the requirement of a text value in the field description.
7. Change the description of the MDL field (Field No. 28) to clarify the contents of the field.
8. Change the description for the UpperControlLimit and LowerControlLimit fields (Field Nos. 35 and 36) to explain when a value is required in those fields.
9. Change the description of the MDLAdjusted field (Field No. 39) to clarify the contents of the field.
10. Change the requirement of the SampleDescription field (Field No. 41) from Required to Conditional. Lab QC samples (method blanks, blank spike, blank spike duplicates) do not appear on the COC.
11. Change the description of the CalRefID field (Field No. 47) to clarify the contents of the field.

EDD Specification Table					
Field Number	**Field Name**	**Data Type**	**Data Length**	**Rqmt**	**Description and Comments**
1	VersionCode	text	15	R	Code identifying the version of the EDD deliverable.
2	LabName	text	10	R	Identification code for the laboratory performing the work. This value is used to distinguish among different facilities.
3	SDG	text	8	R	Sample delivery group designation. Always populated for all samples, including QC.
4	FieldID	text	13	R	Client sample ID as appears on COC with optional lab-assigned suffixes and/or prefixes to make it unique. If the sample identifier on the COC and the prefix/suffix is greater than 13 characters, abbreviate the value but make it unique. For laboratory QC samples (i.e., method blanks, lab control samples), use a unique lab sample identifier.
5	NativeID	text	13	R	Client sample ID, exactly as on the COC. No prefix or suffix allowed. Used to identify the native sample from which other samples are derived (e.g., QAQCType = "LR", "MS", or "SD"). For laboratory QC samples (i.e., method blanks, lab control samples), use a unique lab sample identifier. For lab blank spike (and blank spike duplicate) samples, use the FieldID value that was assigned to the associated method blank.

EDD Specification Table					
Field Number	**Field Name**	**Data Type**	**Data Length**	**Rqmt**	**Description and Comments**
6	QAQCType	text	2	R	This is the code for the sample type. Any field sample that is not used as lab QC and is not otherwise marked on the COC should have the designation of "N" (normal field sample). No suffix allowed (i.e., do not add numbers as suffixes to the QAQCType values as is called for in the ERPIMS guidelines). Note that if all analyses for a given sample are diluted, then the first dilution should be designated as the normal sample. If more dilutions are required, then the next dilution should be designated as the first true dilution with a QAQCType value of "LR" and a LRType value of "DL" (see LRType, below).
7	LRType	text	3	C	This is the code for laboratory replicate sample type. Values are: blank (if QAQCType value is not "LR"), "DL" (dilution), "RE" (re-analysis), "D" (inorganic duplicate), "CF" (confirmation). For multiple dilutions or re-analyses of the same sample, append the replicate number after the LRType value (i.e., "RE", "RE2", "RE3", etc.).
8	Matrix	text	5	R	Sample matrix code. Valid values are as follows: "AIR", "WATER", "SOIL", unless otherwise provided by the project data manager and marked on the COC. The use of "liquid", "solid", etc. for lab QC is not allowed.
9	LabSampleID	text	20	R	Laboratory sample ID. Prefix or suffix is allowed. This is where dilutions or re-extractions are noted. Ex: "D97-11111RE" is acceptable.
10	AnalysisMethod	text	20	R	Analysis method code. This is the identifier of the analytical method that was performed on the sample. Example: SW8260A. Generic names such as "EPA" should not be used.

EDD Specification Table					
Field Number	**Field Name**	**Data Type**	**Data Length**	**Rqmt**	**Description and Comments**
11	ExtractionMethod	text	20	R	Preparation method code. A value in this field is required. If the preparation is described in the method, use "METHOD". If there is no separate preparation required, use "NONE". Note that Total and Dissolved metal analyses are differentiated by the value in this column. Note that Total, TCLP, and SPLP analyses are now differentiated by the value in the LeachMethod column (see below).
12	SampleDate	date		C	Date of sample collection. Value is required for all samples sent to the laboratory and samples derived from those samples. Format: mm/dd/yyyy
13	SampleTime	time		C	Time of sample collection. Value is required for all samples sent to the laboratory and samples derived from those samples. 24-hour format: hh:mm
14	ReceiveDate	date		C	Date of sample receipt in the lab. Value is required for all samples sent to the laboratory and samples derived from those samples. Format: mm/dd/yyyy
15	ExtractDate	date		C	Date of sample preparation (extraction or digestion). Value is required if the ExtractionMethod field value is other than "NONE". Format: mm/dd/yyyy
16	ExtractTime	time		C	Time of sample preparation. Value is required if the ExtractionMethod field value is other than "NONE". 24-hour format: hh:mm
17	AnalysisDate	date		R	Date of sample analysis. Value is required for all records. Format: mm/dd/yyyy
18	AnalysisTime	time		R	Time of sample analysis. Value is required for all records. 24-hour format: hh:mm
19	PercentSolids	number		R	Percent solids within the sample. Should be zero for water samples.

EDD Specification Table					
Field Number	**Field Name**	**Data Type**	**Data Length**	**Rqmt**	**Description and Comments**
20	LabLotCtlNum	text	10	C	Identifier of an autonomous group of environmental samples and associated QC samples **prepared** together. For example, its value can be a digestion or extraction batch ID. If there is no separate extraction or preparation performed, leave this field blank.
21	CAS	text	20	C	CAS number of analyte, if available.
22	ParamID	text	12	R	Parameter identifier code for the parameter listed in the Analyte field.
23	Analyte	text	60	R	Name of analyte, chemical name.
24	Result	text	10	R	Result of the analysis. Surrogate analytes will be reported in units of percent. All others will be reported in sample concentration units. If undetected, report the adjusted MDL or adjusted RL, depending on the project. (Reported as a text field to preserve significant figures.)
25	ExpectedValue	number		C	"100" for surrogates; "0" (zero) for blanks; spike level plus parent result for LCS, and MS/MSD; parent value for lab duplicate; etc.
26	Units	text	10	R	Units of measure used in the analysis. Report "PERCENT" for surrogate analytes and concentration units for all others.
27	Dilution	number		R	Total dilution reported in the analysis. Default value should be 1 (one). This value should reflect changes to sample preparation amounts as defined by the method (e.g., less sample used for standard VOC analysis).
28	MDL	number		C	Minimum detection limit adjusted for preparation and dilution. Note that this value may be the method detection limit or the instrument detection limit, depending on the method and the project requirements. This value is **not** adjusted for percent moisture.
29	RL	number		C	Reporting limit adjusted for preparation and dilution. Value is **not** adjusted for percent moisture. Equivalent to PQL.
30	LabQualifier	text	6	R	Lab qualifier for the results, as reported on the hard copy. Use "=" as first (or only) qualifier value for detected results.
31	Surrogate	text	1	R	Is the chemical a surrogate? Report "Y" for yes or "N" for no.

EDD Specification Table					
Field Number	**Field Name**	**Data Type**	**Data Length**	**Rqmt**	**Description and Comments**
32	Comments	text	240	O	Comment field
33	ParValUncert	text	16	C	Radiological parameter value uncertainty.
34	Recovery	number		C	Percent recovery for MS, SD, LCS, and surrogate compounds.
35	LowerControlLimit	number		C	Lower control limit value for spiked compounds, expressed in units of Percent. A value in this field is required if there is a value in the Recovery field (Field No. 34).
36	UpperControlLimit	number		C	Upper control limit value for spiked compounds, expressed in units of Percent. A value in this field is required if there is a value in the Recovery field (Field No. 34).
37	Basis	text	1	R	Weight basis for soil (or solid) sample analysis. Use "D" for dry-weight basis, "W" for wet-weight basis, or "X" if not applicable.
38	ConcQual	text	1	R	Concentration qualifier. Use "=" for detects, "J" for estimated value (value between detection limit and reporting limit), "U" for undetected result, or "E" for exceeded result.
39	MDLAdjusted	number		C	Minimum detection limit adjusted for preparation, dilution **and percent moisture**. See the description of the MDL field (Field No. 28) for an explanation of the contents of this field.
40	RLAdjusted	number		C	Reporting limit adjusted for preparation, dilution **and percent moisture**. Equivalent to PQL
41	SampleDescription	text	20	C	Full sample identifier value as it appears on the COC. In some cases, this may be the name of the sampling location instead of the sample. Required for all samples that are either collected in the field and specified on the COC, or derived from samples that are collected in the field and specified on the COC.
42	LeachMethod	text	20	R	Analytical method used for leaching the sample. This applies to TCLP, SPLP, or other leaching or pre-extraction leaching procedures. Use "NONE" if the sample was not leached.

EDD Specification Table					
Field Number	**Field Name**	**Data Type**	**Data Length**	**Rqmt**	**Description and Comments**
43	LeachDate	date		C	Date that the leaching method was performed (start date for multi-date leaching procedures). Value is required if the LeachMethod field value is other then "NONE". Format: mm/dd/yyyy.
44	LeachTime	time		C	Time that the leaching procedure started. Value is required if the LeachMethod field value is other then "NONE". 24-hour format: hh:mm.
45	LeachLot	text	20	C	Identifier of an autonomous group of environmental samples and associated QC samples **leached** at the same time. If the sample was not leached, leave this field blank.
46	AnalysisLot	text	20	R	Identifier of an autonomous group of environmental samples and associated QC samples **analyzed** together. A value in this field is mandatory (i.e., it should not be blank).
47	CalRefID	text	20	C	Identifier of a group of environmental and QC samples linked by a common set of calibration records. All results with the same CalRefID value will have had the same initial calibration run.

Each row is uniquely identified by the values in the following fields:

- FieldID
- AnalysisMethod
- ExtractionMethod
- LeachMethod
- ParamID

If an analytical sample must be diluted or reanalyzed and reported in addition to the original analytical sample, the diluted or reanalyzed sample should have a FieldID value that is different that that of the original sample. This can be accomplished through the addition of a suffix to the original FieldID that establishes a new and unique FieldID for the associated records.

Example Valid Values

The project data manager will provide the laboratory with a list of valid values that the laboratory will use in constructing the EDD. Listed below are some example valid values.

Field Name	Valid Value	Meaning
VersionCode	4.00AFCEE3	Format 4.00, AFCEE data values. LabQualifier field contains the laboratory qualifier values defined in the AFCEE QAPP, version 3.0.
VersionCode	4.00EPACLP	Format 4.00, EPA data values. LabQualifier field contains the standard EPA CLP lab qualifiers.
QAQCType	N	Normal, environmental sample
QAQCType	LB	Laboratory method blank
QAQCType	MS	Laboratory matrix spike sample
QAQCType	SD	Laboratory matrix spike duplicate
QAQCType	LR	Laboratory replicate (dilution, re-analysis, duplicate)
QAQCType	BS	Laboratory method blank spike
QAQCType	BD	Laboratory method blank spike duplicate
LRType	DL	First dilution sample
LRType	DL2	Second dilution sample
LRType	DL3	Third dilution sample
LRType	RE	First re-analysis/re-extraction sample
LRType	RE2	Second re-analysis/re-extraction sample

Field Name	Valid Value	Meaning
LRType	RE3	Third re-analysis/re-extraction sample
LRType	D	Inorganic duplicate sample
LRType	CF	First confirmation analysis sample
LRType	CF2	Second confirmation analysis sample
LRType	CF3	Third confirmation analysis sample
AnalysisMethod	SW8260A	Volatiles by method 8260A in EPA SW846.
AnalysisMethod	SW8270	Semivolatiles by method 8270 in EPA SW846.
AnalysisMethod	SW6010	ICP metals by method 6010 in EPA SW846.
AnalysisMethod	SW7060	GFAA Arsenic by method 7060 in EPA SW846.
ExtractionMethod	FLDFLT	Field filtration for dissolved metals analysis
ExtractionMethod	C3050	CLP-modified SW3050 acid digestion for metals analysis in soil samples.
ExtractionMethod	SW1311	TCLP extraction
ExtractionMethod	DISWAT	Distilled water extraction for analytes in soil samples.
ExtractionMethod	SW3510	Separatory funnel extraction
ExtractionMethod	SW3540	Soxhlet extraction
ExtractionMethod	TOTAL	Digestion of unfiltered waters for total metals analysis
ParamID	ACE	Acetone
ParamID	AS	Arsenic

Field Name	Valid Value	Meaning
ParamID	BHCGAMMA	gamma-BHC (Lindane)
ParamID	BZ	Benzene
ParamID	CDS	Carbon disulfide
ParamID	PB	Lead
ParamID	PHENOL	Phenol
ParamID	SE	Selenium
ParamID	TCE	Trichloroethene

Attachment C - Qualifier Flags and Two Digit Code Definitions for Comment Field

The following flags are used in the Data Review and Validation Guidelines and the *USEPA CLP National Functional Guidelines* to qualify the data.

Flag	Meaning	Explanation
U	Undetected	Analyte was analyzed for but not detected above the method detection limit.
UJ	Detection Limit Estimated	Analyte was analyzed for, and qualified as not detected. The result is estimated.
J	Estimated	The analyte was present, but the reported value may not be accurate or precise.
R	Rejected	The data are unusable. (NOTE: Analyte/compound may or may not be present.)

During DV, the validator will apply a two-letter code to the right of each project qualifier applied. This code represents why the compound/element was flagged. The data entry personnel will enter this code into the comment field of the database.

Code	Definition
TN	Tune
BS	Blank Spike/LCS
IS	Internal Standard
MS	Matrix Spike and/or Matrix Spike Duplicate Recovery
MD	Matrix Spike/Matrix Spike Duplicate Precision
2S	Second Source
SD	Serial Dilution
SS	Spiked Surrogate
LR	Analyte present above linear (or calibration) range
IC	Initial Calibration
CC	Continuing Calibration Verification
PD	Pesticide Degradation
LD	Lab Duplicate
2C	Second Column (Confirmation)
HT	Holding Time
PS	Post Spike
BL	Blank
RE	Re-extraction
DL	Dilution
IB	In Between
FD	Field Duplicate
OT	Other

CH2M HILL Site Safety and Health Plan

This Site Safety and Health Plan will be kept on the site during field activities and will be reviewed as necessary. The plan will be amended or revised as project activities or conditions change or when supplemental information becomes available. The plan adopts, by reference, the Standards of Practice (SOPs) in the CH2M HILL Health and Safety Program, Program and Training Manual, as appropriate. In addition, this plan adopts procedures in the project Work Plan. The Site Safety Coordinator (SSC) is to be familiar with these SOPs and the contents of this plan. CH2M HILL's personnel and subcontractors must sign Attachment 1-1. The main object of this project is to conduct a Remedial Investigation/Feasibility Study (RI/FS) on sites SWMU 6, SWMU 7, AOC H, and AOC J. CH2M HILL's SOP HSE-91 for OE is included in Attachment 1-2 of this plan. The SSC will be familiar with HSE-91, but the Unexploded Ordnance Safety Officer (UXOSO) is ultimately responsible for UXO safety.

1.1 Project Information and Description of UXO Safety Officer (UXOSO)

PROJECT NO: 171119.PP.WP

CLIENT: United States Navy

PROJECT/SITE NAME: Remedial Investigation/Feasibility Study (RI/FS) on sites SWMU 6, SWMU 7, AOC H, and AOC J SITE ADDRESS: Vieques Island, Puerto Rico

CH2M HILL PROJECT MANAGER: Martin J. Clasen, P.G.

CH2M HILL OFFICE: Tampa, Florida

DATE HEALTH AND SAFETY PLAN PREPARED: June 10, 2001

DATE(S) OF SITE WORK: August 11, 2003 - September 11, 2003

SITE ACCESS: All investigation sites are located at the Former NASD, in the western portion of Vieques Island, Puerto Rico. SITE SIZE: 8,000 acres

1.1.1 Site Topography

The regional topography of Vieques consists generally of hills and valleys throughout the entire island. The western side of the island consists of gently rolling hills with a deeper soil profile than the eastern, more exposed rugged terrain. The highest point on the western side of the island is found at Mount Pirata with an elevation of 1,000 ft, while the highest point on the eastern side is found at Cerro Matías with an elevation of 420 ft. In addition to the terrain mentioned above, the coastal areas demonstrate their own topography. These areas contain level terrain primarily made up of lagoons and mangrove swamps.

1.1.2 Prevailing Weather

The climate of Vieques is characterized as warm and humid (tropical-marine), with frequent showers occurring throughout the year. The temperature on Vieques is affected by the easterly trade winds blowing across the island year-round. This wind moderates the temperature throughout the year, causing an annual mean temperature of 79°F to 80°F, and a mean daily temperature range of 15°F to 25°F. The average annual rainfall on the island is approximately 36 inches, with extremes being 25 inches in the east and 45 to 50 inches in the west.

1.1.3 Site Description and History

Vieques is the largest offshore island of Puerto Rico, with a surface area of approximately 51 square miles. It is located approximately 7 miles east-southeast of the eastern end of the main island of Puerto Rico, where NSRR is located. The Former NASD occupies the western end of the island of Vieques, encompassing approximately 7,878 acres. The majority of the site is undeveloped and heavily vegetated with trees, low lying brush, and tall grasses. The southwestern portion of the site is the least developed, with the exception of the communications facilities on top of Mount Pirata (within the Former NASD but not technically a part of the site). The central eastern portion of the site was utilized for munitions magazines, which are scattered throughout the area. The northeastern portion of the site is the most developed, containing facilities for the main support compound. The southeastern portion of the site contains the ROTHR station and associated facilities.

The Former NASD was utilized by the U.S. Navy Atlantic Fleet for storage of munitions. The activities at the Former NASD were directed under the consolidated command of Commander Fleet Air Caribbean, Naval Forces Caribbean, and Antilles Defense Command, whose headquarters are at NSRR. The mission of the Former NASD was to receive, store, and issue all ordnance authorized by NSRR for support of Atlantic Fleet activities. Munitions were stored in numerous bunkers located throughout the Former NASD. Other than the bunkers, the only other significant developments at the Former NASD consist of the main support compound located in the northeast portion of the facility, the Mount Pirata telecommunication sites located in the southwest portion of the facility, and the ROTHR site located in the southeastern portion of the facility.

Other activities that were potentially conducted at the Former NASD include amphibious assault training with blank ammunition and pyrotechnics by the U.S. Marines. While the exact location and extent of the Western Training Area (WTA) has not been determined, it is possible that the beach located on the western end of Vieques may have been part of the WTA. This area of beach is known as Green Beach.

Munitions are not currently stored at the Former NASD and no Navy activities are being conducted at the facility, other than operations at the Mount Pirata telecommunication sites and the ROTHR facility. The main support compound is not in operation. Access control for the Former NASD is being provided by contracted security operations.

In accordance with CERCLA and DoD requirements, an EBS of the Former NASD was conducted to assess the possible presence of sites potentially contaminated with hazardous materials resulting from past activities. Through the EBS, the Navy identified 17 areas of potential contamination.

The four sites to be investigated are listed below:

- SWMU 6 - Mangrove Disposal Site
- SWMU 7 - Former Disposal Site
- AOC H - Former Power Plant
- AOC J - Former Operations Area Disposal Site

Figure 1-1 presents the locations of the four RI/FS sites at the Former NASD. As part of the Navy's IRP, these three sites are being investigated in accordance with the CERCLA process to assess the potential presence of hazardous constituents at the sites. During the IR field investigations, UXO technicians were contracted to perform UXO avoidance surveys.

SWMU 6 was used as a base disposal area during the 1960s and 1970s. Trash disposed at the site included cans of lubricants and oil, solvents, paints, and rubble.

SWMU 7 was used as a base disposal area between the early 1960s and the late 1970s. The site is located in a steep ravine that varies from 20 to 30 feet wide, with 10 to 20 foot deep embankments. An estimated volume of 1,500 cubic yards of solid waste was discarded into the ravine by pushing it over the embankment.

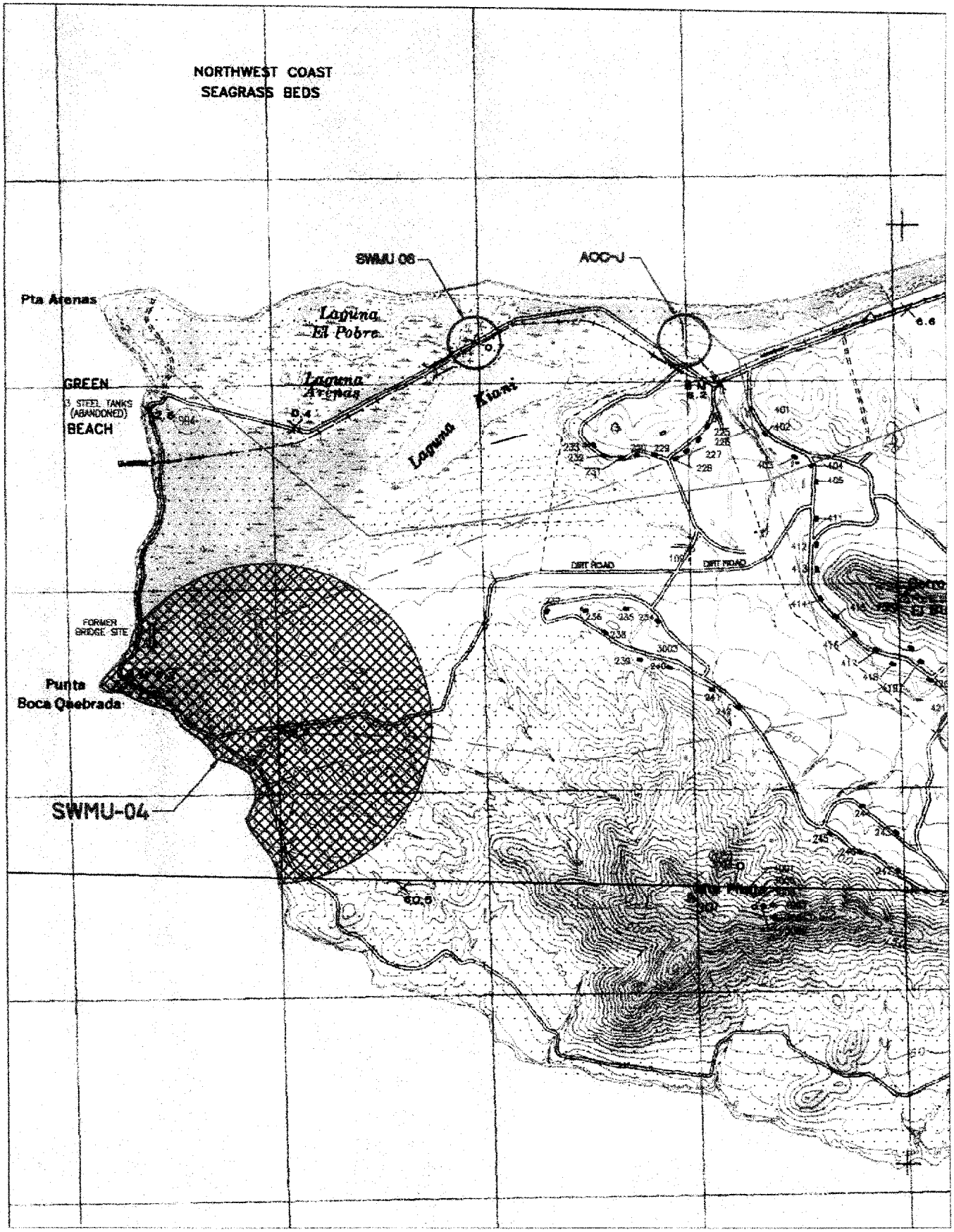
AOC H is an abandoned concrete building approximately 80 feet long and 25 feet wide. The building housed power generation equipment for a period of 3 years prior to Navy activities (1941- 1943). Historically, above ground storage tanks were located on the west side of the building. From the 1960s to 1980, the building was used for fire training which involved pouring diesel fuel over rubber tires to simulate structure fires.

AOC-J was used as a base disposal site from the mid-1960s until 1973, after which the waste was removed from the site and placed in a municipal landfill off-base. Previous visits by another consultant indicated visible debris consisting of scrap metal from construction equipment, UXO, shell casings, glass fragments, and wood.

1.2 Tasks to be Performed Under this Plan

1.2.1 Description of Tasks

Refer to project documents (i.e., Work Plan) for detailed task information. A risk analysis (Section 1.3) has been performed for each task and is incorporated in this plan through task-specific hazard controls and requirements for monitoring and protection. Tasks other than those listed below require an approved amendment or revision to this plan before tasks begin.



T:\Environmental\Puerto Rico Projects\Vieques\Former NASD\Drawings—NASD\UXO Site Location.dwg

Figure 1-1
UXO Site Location Map
Former NASD, Vieques Island, Puerto Rico

CH2MHILL

1.2.1.1 Hazwoper-Regulated Tasks

- Site Layout
- Surface geophysical surveys
  - Magnetic
  - Electromagnetic
- Vegetation removal
- UXO Avoidance

- Soil Sampling
- Monitoring Well Construction and Sampling
- Surface Water/Sediment Sampling
- Hand auguring
- Surveying
- Investigation-derived waste (drum) sampling and disposal

1.2.1.2 Non-Hazwoper-Regulated Tasks

Under specific circumstances, the training and medical monitoring requirements of federal or state Hazwoper regulations are not applicable. It must be demonstrated that the tasks can be performed without the possibility of exposure in order to use non-Hazwoper-trained personnel. **Prior approval from the Health and Safety Manager (HSM) is required before these tasks are conducted on regulated hazardous waste sites.**

1.3 Activity Hazard Analysis for RI/FS

Table 1-1 shows hazards analysis, and Table 1-2 shows inspection requirements.

Potential Hazards	Tasks									
	Test pit/ excavation	Drilling, geoprobe, and well installation & abandonment	Groundwater monitoring, aquifer testing	Surface water and sediment sampling using a boat	Surface water and sediment sampling from the shore or water	Hand augering	Surveying	IDW drum sampling and disposal	Observation of loading material for offsite disposal	Remediation & construction oversight
Flying debris/objects	X	X		X	X	X		X	X	X
Noise > 85dBA	X	X		X					X	X
Electrical	X	X	X	X						X
Suspended loads	X	X		X					X	X
Buried utilities, drums, tanks	X	X				X				X
Slip, trip, fall	X	X	X	X	X	X	X	X	X	X
Back injury	X	X	X	X	X	X		X		X
Confined space entry	X						X			X
Trenches / excavations	X									X
Visible lightning	X	X	X	X	X	X	X	X	X	X
Vehicle traffic									X	X
Elevated work areas/falls	X				X					X
Fires	X	X			X			X		X
Entanglement		X				X				
Drilling		X								
Heavy equipment	X	X		X					X	X
Working near water					X					
Working from boat				X						
IDW Drum Sampling								X		

1.4 Hazard Controls

This section provides safe work practices and control measures used to reduce or eliminate potential hazards. These practices and controls are to be implemented by the party in control of either the site or the particular hazard. CH2M HILL employees and subcontractors must remain aware of the hazards affecting them regardless of who is responsible for controlling the hazards. CH2M HILL employees and subcontractors who do not understand any of these provisions should contact the SSC or UXOSO for clarification.

1.4.1 Project-Specific Physical (Safety) Hazards

The main physical or safety hazards posed to CH2M HILL personnel during project activities are:

- Thermal (heat) stress
- Noise
- Explosion and fire
- Utilities
- Heavy equipment
- Fall hazards
- Ordnance
- Power tools
- Manual vegetation removal equipment

The health and safety control measures for these hazards are outlined in the following section of this plan.

1.4.1.1 UXO Avoidance

(Reference CH2MHILL SOP HS-91, *Explosive Ordnance*)

- All intended site work must be reviewed and approved by the CH2MHILL UXO Safety Officer.
- Only qualified UXO personnel will perform UXO work.
- Field work will not be performed in areas of the site that have not been cleared by qualified UXO personnel.
- Should objects and materials suspected of being UXO be discovered site work will be suspended immediately and the presence of the object must be reported to the UXO Competent Person immediately.

1.4.2 General Hazards and Housekeeping

- Site work will be performed only during daylight hours.
- Hearing protection must be worn in areas where you need to shout to hear someone within 3 ft.

- Good housekeeping must be maintained at all times in all project work areas.
- Common paths of travel should be established and kept free from the accumulation of materials.
- Keep access to aisles, exits, ladders, stairways, scaffolding, and emergency equipment free from obstructions.
- Provide slip-resistant surfaces, ropes, and/or other devices to be used.
- Stairs or ladders are generally required when there is a break in elevation of 19 inches or more.
- Specific areas should be designated for the proper storage of materials.
- Tools, equipment, materials, and supplies shall be stored in an orderly manner.
- As work progresses, scrap and unessential materials must be neatly stored or removed from the work area.
- Containers should be provided for collecting trash and other debris and shall be removed at regular intervals.
- All spills shall be quickly cleaned up. Oil and grease shall be cleaned from walking and working surfaces.

1.4.3 Hazard Communication

The SSC or UXOSO is to perform the following:

- Complete an inventory of chemicals brought onsite by CH2M HILL using Attachment 1-3.
- Confirm that an inventory of chemicals brought onsite by CH2M HILL subcontractors is available.
- Request or confirm locations of Material Safety Data Sheets (MSDSs) from LANTDIV, contractors, and subcontractors for chemicals to which CH2M HILL employees potentially are exposed.
- Before or as the chemicals arrive onsite, obtain an MSDS for each hazardous chemical.
- Label chemical containers with the identity of the chemical and with hazard warnings, and store properly.
- Give employees required chemical-specific HAZCOM training using Attachment 1-3.

1.4.4 Shipping and Transportation of Chemical Products

Chemicals are not expected to be needed as part of the field efforts. If chemicals are determined to be necessary, these chemicals might be defined as hazardous materials by DOT. All staff who ship the materials or transport them by road must receive CH2M HILL training in shipping dangerous goods. All hazardous materials that are shipped (e.g., via Federal Express) or are transported by road must be properly identified, labeled, packed, and documented by trained staff. Contact the HSM or the Equipment Coordinator for additional information.

1.4.5 Manual Lifting

Proper lifting techniques must be used when lifting any object.

- Plan storage and staging to minimize lifting or carrying distances.
- Split heavy loads into smaller loads.
- Use mechanical lifting aids whenever possible.
- Have someone assist with the lift, especially for heavy or awkward loads.
- Make sure the path of travel is clear prior to the lift.

1.4.6 Slips, Trips and Falls

- Institute and maintain good housekeeping practices.
- Pick up tools and debris in the work area.
- Walk or climb only on equipment surfaces designed for personnel access.
- Be aware of poor footing and potential slipping and tripping hazards in the work area.

1.4.7 Fire Prevention

- Fire extinguishers shall be provided so that the travel distance from any work area to the nearest extinguisher is less than 100 ft. When 5 gallons or more of a flammable or combustible liquid is being used, an extinguisher must be within 50 ft. Extinguishers must:
  - Be maintained in a fully charged and operable condition
  - Be visually inspected each month
  - Undergo a maintenance check each year
- The area in front of extinguishers must be kept clear.
- Post "Exit" signs over exiting doors, and post "Fire Extinguisher" signs over extinguisher locations.
- Combustible materials stored outside should be at least 10 ft from any building.
- Solvent waste and oily rags must be kept in a fire-resistant, covered container until removed from the site.
- Flammable/combustible liquids must be kept in approved containers, and must be stored in an approved storage cabinet.

1.4.8 Electrical

- All temporary wiring, including extension cords, must have ground fault circuit interrupters (GFCIs) installed.
- Extension cords must be:
  - Equipped with third-wire grounding
  - Covered, elevated, or protected from damage when passing through work areas
  - Protected from pinching if routed through doorways
- Electrical power tools and equipment must be effectively grounded or double-insulated UL-approved.

- Electrical power tools, equipment, and cords are to be inspected for damage before use. If damaged, they should be tagged and removed from service.
- Operate and maintain electrically powered equipment according to manufacturer's instructions.
- Protect all electrical equipment, tools, switches, and outlets from elements.
- Only qualified personnel are to work on energized electrical circuits and equipment. Only authorized personnel are permitted to enter high-voltage areas.
- Properly label switches, fuzes, and breakers.
- All 120-volt, single-phase 15 and 20 ampere receptacle outlets on construction sites, which are not part of the permanent building wiring, must be equipped with GFCIs for personnel protection.
- All portable electric generator receptacles must be effectively grounded by bonding the receptacle grounding wire to the generator frame.

1.4.9 Ladders

- Ladders must be inspected by a competent person for visible defects prior to each day's use. Defective ladders must be tagged and removed from service.
- Portable ladders must extend at least 3 ft above landing surface.
- User must face the ladder when climbing; keep belt buckle between side rails.
- User must use both hands to climb; use rope to raise and lower equipment and materials.
- Straight and extension ladders must be tied off to prevent displacement.
- Ladders that may be displaced by work activities or traffic must be secured or barricaded.
- Fixed ladders >20 ft in height must be provided with fall-protection devices.
- Stepladders are to be used in the fully opened and locked position.
- Users are not to stand on the top two steps of a stepladder; nor are users to sit on top of or straddle a stepladder.
- Straight and extension ladders must be positioned at such an angle that the ladder base to the wall is one-fourth of the working length of the ladder.

1.4.10 Heat and Cold Stress

1.4.10.1Preventing and Treating Heat Stress

- Drink 16 ounces of water before beginning work. Disposable cups and water maintained at 50°F to 60°F should be available. Under severe conditions, drink 1 to 2 cups every 20 minutes, for a total of 1 to 2 gallons per day. Take regular breaks in a cool, shaded area. Do not use alcohol in place of water or other nonalcoholic fluids. Decrease your intake of coffee and caffeinated soft drinks during working hours.

- Acclimate by slowly increasing workloads (e.g., do not begin with extremely demanding activities).
- Use cooling devices, such as cooling vests, to aid natural body ventilation The devices add weight, so their use should be balanced against efficiency.
- Use mobile showers or hose-down facilities to reduce body temperature and cool protective clothing.
- Conduct field activities in the early morning or evening and rotate shifts of workers, if possible.
- Provide adequate shelter or shade to protect personnel against radiant heat (sun, flames, hot metal).
- Maintain good hygiene standards by frequently changing clothing and showering.
- Monitor buddy for signs of heat stress. Persons who experience signs of heat rash or heat cramps should consult the UXOSO or SSC to avoid progression of heat-related illness.
- Those who experience heat syncope (sudden fainting), heat exhaustion (hot, pale, clammy/moist skin), or heat stroke (red, hot, dry skin; loss of consciousness) must be cooled down immediately and provided cool water or sports drink. Persons who experience heat syncope or heat exhaustion should also seek medical attention as soon as possible. Persons who experience heat stroke must get immediate medical attention.

1.4.10.2Monitoring Heat Stress

These procedures should be considered when the ambient air temperature exceeds 70°F, the relative humidity is high (>50 percent), or when workers exhibit symptoms of heat stress.

The heart rate (HR) should be measured by the radial pulse for 30 seconds, as early as possible in the resting period. The HR at the beginning of the rest period should not exceed 100 beats/minute, or 20 beats/minute above resting pulse. If the HR is higher, the next work period should be shortened by 33 percent, while the length of the rest period stays the same. If the pulse rate still exceeds 100 beats/minute at the beginning of the next rest period, the work cycle should be further shortened by 33 percent. The procedure is continued until the rate is maintained below 100 beats/minute, or 20 beats/minute above resting pulse.

1.4.10.3Preventing and Treating Cold Stress

- Be aware of the symptoms of cold-related disorders, and wear proper clothing for the anticipated fieldwork.
- Consider monitoring the work conditions and adjusting the work schedule using guidelines developed by the U.S. Army (wind-chill index) and the National Safety Council (NSC) (CH2M HILL SOP HS-09).
- Wind-chill index is used to estimate the combined effect of wind and low air temperatures on exposed skin. The wind-chill index does not take into account the body part that is exposed, the level of activity, or the amount or type of clothing worn. For those reasons, it is

used only as a guideline to warn workers when they are in a situation that can cause cold-related illnesses.

- NSC Guidelines for work and warm-up schedules can be used with the wind-chill index to estimate work and warm-up schedules for fieldwork. The guidelines are not absolute; workers should be monitored for symptoms of cold-related illnesses. If symptoms are not observed, the work duration can be increased.
- Persons who experience signs of incipient frost bite (frost nip) or incipient hypothermia (generally cold, shivering) should consult the UXOSO to avoid progression of cold-related illness.
- Persons who experience signs of frost bite (discolored, waxy, resilient skin) or hypothermia (low body temperature characterized by uncontrollable shivering, weakness, apathy, etc.) must be warmed and provided warm fluids (not hot, and no caffeinated drinks), and must get immediate medical attention.

1.4.11 Compressed Gas Cylinders

- Valve caps must be in place when cylinders are transported, moved, or stored.
- Cylinder valves must be closed when cylinders are not being used and when cylinders are being moved.
- Cylinders must be secured in an upright position at all times.
- Cylinders must be shielded from welding and cutting operations, and must be positioned to avoid being struck or knocked over; contacting electrical circuits; or being exposed to extreme heat sources.
- Cylinders must be secured on a cradle, basket, or pallet when hoisted; they may not be hoisted by choker slings.

1.4.12 Procedures for Locating Buried Utilities

Local Utility Mark-Out Service

Name: Ondeo (formerly PRASA) - water utilities

Phone: (787) 741-2001

Name: Caleb Romero, NSSR, Puerto Rico
Phone: (787) 865-4429, Ext. 4068/4268

- Where available, obtain utility diagrams for the facility.
- Review locations of sanitary and storm sewers, electrical conduits, water supply lines, natural gas lines, and fuel tanks and lines.
- Review proposed locations of intrusive work with facility personnel knowledgeable of locations of utilities. Check locations against information from utility mark-out service.
- Where necessary (e.g., uncertainty about utility locations), excavation or drilling of the upper depth interval should be performed manually.

- Monitor for signs of utilities during advancement of intrusive work (e.g., sudden change in advancement of auger or split spoon).
- When LANTDIV or another onsite party is responsible for determining the presence and locations of buried utilities, the UXOSO should confirm that arrangement.

1.4.13 Working Near Water

When working near water, and there is a risk of drowning:

- U.S. Coast Guard-approved personal flotation devices (PFDs), or life jackets, provided for each employee will be worn.
- PFDs will be inspected before and after each use. Defective equipment will not be used.
- Sampling and other equipment will be used according to the manufacturer's instructions.
- A minimum of one life-saving skiff will be provided for emergency rescue.
- A minimum of one ring buoy with 90 ft of 3/8-inch solid-braid polypropylene (or equal) rope will be provided for emergency rescue.

1.4.14 Working on Water

- Safe means of boarding or leaving a boat or a platform will be provided to prevent slipping and falling.
- The boat/barge must be equipped with adequate railing.
- Employees should be instructed on safe use.
- Work requiring the use of a boat will not take place at night or during inclement weather.
- The boat/barge must be operated according to U.S. Coast Guard regulations (speed, lightning, right-of-way, etc.).
- The engine should be shut off before refueling; do not smoke while refueling.

1.4.15 IDW Drum Sampling

Personnel are permitted to handle or sample drums containing IDW only; handling or sampling other drums requires a plan revision or amendment approved by the CH2M HILL HSM. The following control measures will be taken when sampling drums containing IDW:

- Minimize transportation of drums.
- Sample only labeled drums or drums known to contain IDW.
- Use caution when sampling bulging or swollen drums. Relieve pressure slowly.
- If drums contain (or potentially contain) flammable materials, use non-sparking tools to open.
- Picks, chisels, and firearms may not be used to open drums.

- Reseal bung holes or plugs whenever possible.
- Avoid mixing incompatible drum contents.
- Sample drums without leaning over the drum opening.
- Transfer the content of drums using a method that minimizes contact with material.
- PPE and air monitoring requirements specified in Sections 1.6 and 1.7 must address IDW drum sampling.
- Spill-containment procedures specified in Section 1.9 must be appropriate for the material to be handled.

1.4.16 Confined Space Entry

No confined space entry will be permitted. Confined space entry requires additional health and safety procedures, training, and a permit. If conditions change such that confined-space entry is necessary, contact the HSM to develop the required entry permit.

When planned activities will not include confined-space entry, permit-required confined spaces accessible to CH2M HILL personnel are to be identified before the task begins. The SSC is to confirm that permit spaces are properly posted or that employees are informed of their locations and hazards.

1.4.17 Working Around Material Handling Equipment

- Never approach operating equipment from the rear. Always make positive contact with the operator, and confirm that the operator has stopped the motion of the equipment.
- Never approach the side of operating equipment; remain outside of the swing and turning radius.
- Maintain distance from pinch points of operating equipment.
- Because heavy equipment may not be equipped with properly functioning reverse signal alarms, never turn your back on any operating equipment.
- Never climb onto operating equipment or operate contractor/subcontractor equipment.
- Never ride contractor/subcontractor equipment unless it is designed to accommodate passengers, and is equipped with a firmly attached passenger seat.
- Never work or walk under a suspended load.
- Never use equipment as a personnel lift; do not ride excavator buckets or crane hooks.
- Always stay alert and maintain a safe distance from operating equipment, especially equipment on cross slopes and unstable terrain.

1.4.18 Biological Hazards and Controls

1.4.18.1Snakes

No poisonous snakes are indigenous to Puerto Rico.

Snakes typically are found in underbrush and tall grassy areas. If you encounter a snake, stay calm and look around; there may be other snakes. Turn around and walk away on the same path you used to approach the area. If a person is bitten by a snake, wash and immobilize the injured area, keeping it lower than the heart if possible. Seek medical attention immediately. DO NOT apply ice, cut the wound, or apply a tourniquet. Try to identify the type of snake: note color, size, patterns, and markings.

1.4.18.2Poison Ivy and Poison Sumac

Poison ivy, poison oak, and poison sumac typically are found in brush or wooded areas. They are more commonly found in moist areas or along the edges of wooded areas. Become familiar with the identity of these plants. Wear protective clothing that covers exposed skin and clothes. Avoid contact with plants and the outside of protective clothing. If skin contacts a plant, wash the area with soap and water immediately. If the reaction is severe or worsens, seek medical attention.

1.4.18.3Ticks

Ticks typically are in wooded areas, bushes, tall grass, and brush. Ticks are black, black and red, or brown and can be up to one-quarter inch in length. Wear tightly woven light-colored clothing with long sleeves and pant legs tucked into boots; spray only outside of clothing with permethrin or permanone and spray skin only with DEET. Check yourself frequently for ticks.

If bitten by a tick, grasp it at the point of attachment and carefully remove it. After removing the tick, wash your hands and disinfect and press the bite areas. Save the removed tick. Report the bite to human resources. Look for symptoms of Lyme disease or Rocky Mountain spotted fever (RMSF). Lyme: a rash might appear that looks like a bullseye with a small welt in the center. RMSF: a rash of red spots might appear under the skin 3 to 10 days after the tick bite. In both cases, chills, fever, headache, fatigue, stiff neck, and bone pain may develop. If symptoms appear, seek medical attention.

1.4.18.4Bees and Other Stinging Insects

Bee and other stinging insects may be encountered almost anywhere and may present a serious hazard, particularly to people who are allergic. Watch for and avoid nests. Keep exposed skin to a minimum. Carry a kit if you have had allergic reactions in the past, and inform the SSC and/or buddy. If a stinger is present, remove it carefully with tweezers. Wash and disinfect the wound, cover it, and apply ice. Watch for allergic reaction; seek medical attention if a reaction develops.

1.4.18.5Bloodborne Pathogens

Exposure to bloodborne pathogens may occur when rendering first aid or cardio-pulmonary resuscitation (CPR), or when coming into contact with landfill waste or waste streams containing potentially infectious material. Exposure controls and PPE are required as specified in CH2M HILL SOP HS-36, Bloodborne Pathogens. Hepatitis B vaccination must be offered before the person participates in a task where exposure is a possibility.

1.4.18.6Other Anticipated Biological Hazards

The following paragraphs identify the potential hazards associated with flora and fauna at the site. If additional concerns are identified, they will be added to this SSHP.

Hazardous Flora. Incidence of contact by individuals to poisonous and thorny plants is high, especially during surface water and sediment sampling activities; therefore, bare skin should be covered (i.e., long pants and shirt, steel-toed boots, leather or cotton gloves, safety glasses, and head protection) as much as practical when working in forested or densely vegetated areas. Personnel should avoid entering an area in the direct path of known poisonous flora; a secondary route should be selected. Care should also be taken when walking in such areas because uneven terrain or vines may present a tripping hazard.

While attempting to cut into dense underbrush, hazards exist from the sharp machete and gas-powered weed cutter. Therefore, care should be taken when using such devices. (Note: Hearing protection, steel-toed boots, gloves, and safety glasses are required when using weed cutters.) All rashes and other injuries will be reported to the SSC as soon as they are known.

Hazardous Fauna. Mosquitoes and sand flies pose a nuisance and physical hazard to field personnel; they distract workers, leading to accidents, and pose a physical threat by transmitting live microorganisms. Sand fly bites that are repeatedly scratched can cause secondary infections. Avoid the use of perfumes and scented deodorants, and don light colored clothing. The use of Avon's "Skin So Soft" or other insect repellent is encouraged.

The potential exists to come in contact with other dangerous insects; these include centipedes, fire ants, bees, wasps, hornets, mites, fleas, and spiders. All personnel should perform "checks" on each other periodically and at the end of the work shift, especially when working in grassy or forested areas. All insect bites must be reported to the SSC.

No poisonous snakes are indigenous to Puerto Rico, only non-poisonous snakes such as the Boa Constrictor. Feral (wild) dogs and cats have been observed.

Mongeese, rats, and mice have been documented to (potentially) carry rabies. There is some evidence that mongeese can be infected with the rabies virus in an attenuated form, allowing them to carry and spread the virus for a considerable time before succumbing to the disease. Any observed unusual behavior by mongeese and other mammals must be reported. Signs of rabies can be characterized in two forms. Animals with furious rabies exhibit agitation and viciousness, followed by paralysis and death. Animals with dumb rabies exhibit lethargy and paralytic symptoms, followed by death. Behavioral indicators for both include fearlessness and change in nocturnal/diurnal rhythms.

Working in wet or swampy areas unprotected shall not be allowed because of the presence of a variety of etiologic (disease-causing) agents. Contact with surface water will be kept to a minimum. There have been several incidents of infection by schistosomes (blood flukes) from contact with surface water. The aquatic snail vector, *Australorbis glabratus*, transmits the schistosomes into surface waters, predominantly drainage ditches. Even momentary contact (especially in the presence of blisters, cuts, and open sores) with contaminated surface water is sufficient to acquire an infection. Accidental skin contact requires that the area be washed with isopropyl alcohol (as directed by SSC). Symptoms of infection are fever, diarrhea, itchy skin,

and central nervous system (CNS) damage. Schistosomiasis is hard to treat; once established in its host, it may remain for several years.

Before beginning site activities, each individual shall be questioned as to any known sensitivities to the previously mentioned organisms or agents.

Dengue Fever and Other Illnesses. According to the Centers for Disease Control (CDC), Dengue Fever is primarily a viral infection transmitted by mosquito bites in residential areas. The mosquitoes are most active during the day, especially around dawn and dusk, and are frequently found in and around human habitations. The illness is flu-like and characterized by sudden onset, high fever, severe headaches, joint and muscle pain, and rash. The rash appears 3 to 4 days after the onset of fever. Because there is no vaccine or specific treatment, prevention is important. To reduce mosquito bites, travelers should wear clothes that cover most of the body. Travelers should also take insect repellent with them to use on any exposed areas of skin. The most effective repellent is DEET (N,N-diethyl meta-toluamide). Avoid applying high-concentration DEET (greater than 35 percent) products to the skin and refrain from applying repellent to portions of the hands that are likely to come in contact with the eyes and mouth. Rarely, toxic reactions or other problems have developed after contact with DEET. Please note that personnel performing water sampling should refrain from using DEET because the breakdown products can show up as false positive results in lab analysis. For greater protection, clothing can be soaked in or sprayed with permethrin, which is an insect repellent licensed for use on clothing. If applied according to directions, permethrin will repel insects from clothing for several weeks.

Traveler's Diarrhea is the most frequent health problem for travelers. It can be caused by viruses, bacteria, or parasites that are found universally throughout the region. Transmission is most often through contaminated food or water. Purchase food and beverages from vendors that are professional. Avoid small roadside stands and drink bottled beverages when possible. The use of over-the-counter or prescriptions medications can reduce the length of the attack. Although the potable water supply (from the tap) in Vieques is generally of excellent quality, field personnel should take precautions if they have a known sensitivity to chlorine.

Hepatitis A is a viral infection of the liver transmitted by the fecal oral route; through direct person to person contact; from contaminated water, ice, or shellfish; or from fruits or uncooked vegetables contaminated through handling. Symptoms include fatigue, fever, loss of appetite, nausea, dark urine, jaundice, vomiting, aches and pains, and light stools. No specific therapy supportive care is available, only supportive care. The virus is inactivated by boiling or cooking to 85°C for 1 minute. Therefore, eating thoroughly cooked foods and drinking only treated water serve as general precautions. CDC recommends hepatitis A vaccine as a precaution.

Fire Ant Bites. Fire ants typically build mounds on the land surface that are usually easy to identify. Avoid disturbing these mounds. A bite from a fire ant can be painful but rarely is life threatening. It is possible, however, that the bite could cause an allergic reaction. If bitten, check for symptoms of an allergic reaction such as weakness, nausea, vomiting, dizziness, or shortness of breath. If symptoms appear, seek medical attention.

1.4.19 Radiological Hazards and Controls

Radiological hazards are not expected at this site. If new or additional information is provided that indicates that radiological hazards may be present, stop work and refer to CH2M HILL's

Health and Safety Program, Program and Training Manual, and Health and Safety Program Radiation Protection Manual for SOPs in contaminated areas.

1.4.20 Contaminants of Concern

Contaminants of potential concern (COPCs) at SWMU 6, SWMU 7, AOC -H and J, include the following general categories of waste:

- Pesticides/Herbicides
- Waste Solvents/Fuels
- Spent Batteries/Battery Acid
- Waste Oils

Table 1-3 shows potential exposure routes.

TABLE 1-3
Potential Routes of Exposure

Dermal: Contact with contaminated media. This route of exposure is minimized through proper use of PPE, as specified in Section 1.6.	**Inhalation**: Vapors and contaminated particulates. This route of exposure is minimized through proper respiratory protection and monitoring, as specified in Sections 1.6 and 1.7, respectively.	**Other**: Inadvertent ingestion of contaminated media. This route should not present a concern if good hygiene practices are followed (e.g., wash hands and face before drinking or smoking).

1.4.20.1Pesticides/Herbicides

There are various kinds of pesticides and herbicides. Generally, the main health concern is from volatile organic compounds (VOCs). The physical hazard associated with this group is flammability. A wide range of overexposure symptoms exists for VOCs, including: mucous membrane irritation, coughing, nausea and vomiting, dizziness, confusion, and unconsciousness.

1.4.20.2Waste Solvents/Fuels

The greatest physical hazards associated with many solvents result from their flammability. Solvents may cause dermatitis and dry skin with prolonged exposure, and are poisonous if ingested. Inhalation causes narcosis, a feeling of light-headedness, dizziness or euphoria, as well as headaches and nausea. Long-term exposure from ingestion or inhalation can lead to kidney and liver damage.

Contact with lighter fuels causes rapid drying of the skin, leading to chapping, cracked skin, and dermatitis. Vapors are irritating to eyes, nose, and throat. Inhalation leads to dizziness, nausea, and headaches. Ingestion is poisonous, causing damage to CNS, kidneys, and liver.

1.4.20.3Spent Batteries/Battery Acid

Skin and eyes can be burned from direct contact with acid. Inhaled acid fumes can burn the respiratory tract, including the mouth, nose, throat, and lungs. Lungs burned with acid fumes often develop pulmonary edema, a condition in which the lungs fill with fluid, making breathing difficult.

1.4.20.4Waste Oils

Waste oils will cause skin irritation from prolonged contact and are generally toxic if ingested. The physical hazard associated with oil is combustibility.

The data presented in a chemical/material data sheet reflect the chemical and toxicological properties of the specific compound in a pure, non-diluted state. As such, when these compounds are detected in environmental media (i.e., soil, groundwater, sediment, and surface water), the hazards are anticipated to be substantially less than those associated with exposure to pure compounds. The data presented in these data sheets, therefore, will be utilized as reference information when questions arise as to a constituent's chemical and toxicological properties or measures for emergency response.

Note: Likely contaminants are described below for SWMU 6, SWMU 7, AOC-H and AOC-J. However, this Site Safety and Health Plan is intended for use at all sites at the Former NASD.

SWMU 6 – Mangrove Disposal Site. Previous investigations included the collection of soil, sediment, surface water, and groundwater samples for VOCs, SVOCs, pesticides, PCBs, and metals analysis. Parameters exceeding screening criteria in surface soils included aluminum, antimony, arsenic, iron, lead, thallium, and benzo(a)pyrene. In subsurface soils, only arsenic exceeded screening criteria. Parameters exceeding screening criteria in groundwater included aluminum, arsenic, barium, cadmium, iron, lead, manganese, PCB-1221, and PCB-1232. In surface water, arsenic, copper, lead, mercury, and silver exceeded screening criteria. Parameters exceeding screening criteria in sediment included arsenic, chromium, copper, lead, nickel, and zinc. The metals detected at the site were detected at levels indicative of background concentrations for the island.

SWMU 7 – Quebrada Disposal Site. Previous investigations included the collection of soil, sediment, surface water, and groundwater samples for VOCs, SVOCs, pesticides, PCBs, and metals analysis. Parameters exceeding screening criteria in surface soils included aluminum, antimony, arsenic, iron, lead, thallium, and benzo(a)pyrene. In subsurface soils, only arsenic exceeded screening criteria. Parameters exceeding screening criteria in groundwater included aluminum, arsenic, barium, cadmium, iron, lead, manganese, PCB-1221, and PCB-1232. In surface water, arsenic, copper, lead, mercury, and silver exceeded screening criteria. Parameters exceeding screening criteria in sediment included arsenic, chromium, copper, lead, nickel, and zinc. The metals detected at the site were detected at levels indicative of background concentrations for the island.

AOC-H – Power Plant. Previous investigations at the site included collection of surface soil and subsurface soil, and groundwater samples near the building as well as surface soil samples inside the building itself. The samples were analyzed for VOCs, SVOCs, pesticides, PCBs, and metals. Analytical results of soil samples showed elevated levels of SVOCs, pesticides, explosives, and metals..

AOC-J – Former Staging Area Disposal Site. During a site visit conducted by CH2M HILL at the site on September 14, 2000, 106 mm shell casings and 20 mm ammunition boxes were observed. Previous visits by ERM indicated visible debris consisting of scrap metal from construction equipment, UXO, shell casings, glass fragments, and wood waste. Previous investigations at the site included collection of soil samples near the visible disposal areas. The samples were

analyzed for VOCs, SVOCs, pesticides, PCBs, and metals. Analytical results of soil samples showed no elevated levels of any constituents of concern for this site.

1.5 Project Organization and Personnel

1.5.1 CH2M HILL Employee Medical Surveillance and Training

The employees listed below are enrolled in the CH2M HILL Comprehensive Health and Safety Program and meet state and federal hazardous waste operations requirements for 40-hour initial training, 3-day on-the-job experience, and 8-hour annual refresher training. Employees designated SSC have completed a 12-hour site safety coordinator course, and have documented requisite field experience. An SSC with a level designation (D, C, B) equal to or greater than the level of protection being used must be present during all tasks performed in exclusion or decontamination zones. Employees designated "FA-CPR" are currently certified by the American Red Cross, or equivalent, in first aid and CPR. At least one FA-CPR designated employee must be present during all tasks performed in exclusion or decontamination zones. The employees listed in Table 1-4 are currently active in a medical surveillance program that meets state and federal regulatory requirements for hazardous waste operations. Certain tasks (e.g., confined-space entry) and contaminants (e.g., lead) may require additional training and medical monitoring.

TABLE 1-4
CH2M HILL Employees Currently in Medical Surveillance Program

Employee Name	Office	Responsibility	SSC/FA-CPR
Marty Clasen	TPA	Project Manager	Level D SSC; FA-CPR
Erik Isern	TPA	Field Team Leader	Level D SSC; FA-CPR
Mariana Brown	TPA	Field Team Member	Level D; FA-CPR
Rick Gorsira	TPA	Field Team Leader	Level D SSC; FA-CPR
Tim McDonald	TUL	Field Team Member	Level D, SSC, FA-CPR

Field Team Chain of Command and Communication Procedures

Client

Contact Name: Chris Penny, RPM
Phone: (757) 322-4815
Facility Contact Name: Not Available (N/A)
Phone: N/A

CH2M HILL

Project Manager: Marty Clasen/TPA
Health and Safety Manager: Michael Goldman/ATL
Field Team Leader and SSC: Rick Gorsira/TPA

CH2M HILL Subcontractors

Subcontractor: USA Environmental
Subcontractor Contact Name: Dan Miller, SUXOS
Phone: (813) 786-0785 (cell)

Subcontractor: Environmental Drilling Services
Subcontractor Contact Name: Doug Leonhardt
Phone: (407) 295-3532

The subcontractors listed above are covered by this SSHP and must be provided a copy of this plan. This plan does not, however, address hazards associated with the tasks and equipment in which the subcontractor has expertise (e.g., UXO avoidance). Subcontractors are responsible for the health and safety procedures specific to their work, and are required to submit these procedures to CH2M HILL for review before the start of field work. Subcontractors must comply with the established health and safety plan(s). The CH2M HILL SSC should verify that subcontractor employee training, medical clearance, and fit test records are current and must monitor and enforce compliance with the established plan(s). CH2M HILL's oversight does not relieve subcontractors of their responsibility for effective implementation and compliance with the established plan(s).

CH2M HILL should continuously endeavor to observe subcontractors' safety performance. This endeavor should be reasonable, and should include observing for hazards or unsafe practices that are both readily observable and occur in common work areas. CH2M HILL is not responsible for exhaustive observation for hazards and unsafe practices. In addition to this level of observation, the SSC is responsible for confirming CH2M HILL subcontractor performance against both CH2M HILL's and the subcontractor's SSHPs.

Health and safety related communications with CH2M HILL subcontractors should be conducted as follows:

- Brief subcontractors on the provisions of this plan, and require them to sign the Employee Signoff Sheet included in Attachment 6-1.
- Ask subcontractor(s) to brief the project team on the hazards and precautions related to their work.

- When apparent non-compliance/unsafe conditions or practices are observed, notify the subcontractor safety representative and require corrective action; the subcontractor is responsible for determining and implementing necessary controls and corrective actions.
- When repeated non-compliance/unsafe conditions are observed, notify the subcontractor safety representative and stop affected work until adequate corrective measures are implemented.
- When an apparent imminent danger exists, immediately remove all affected CH2M HILL employees and subcontractors, notify subcontractor safety representative, and stop affected work until adequate corrective measures are implemented. Notify the Project Manager and HSM as appropriate.
- Document all oral health and safety related communications in the project field logbook, daily reports, or other records.

Contractors

This plan does not address contractors who are contracted directly to LANTDIV. CH2M HILL is not responsible for the health and safety or means and methods of the contractor's work, and must never assume such responsibility through our actions (e.g., advising on safety and health issues). In addition to this plan, CH2M HILL staff should review contractor safety plans so staff remain aware of appropriate precautions that apply to CH2M HILL. Except in unusual situations when conducted by the HSM, CH2M HILL must never comment on or approve contractor safety procedures. Self-assessment checklists contained in Attachment 6-5 are to be used by the SSC to review the contractor's performance ***only*** as it pertains to evaluating our exposure and safety.

Safety and health-related communications with contractors should be conducted as follows:

- Ask the contractor to brief CH2M HILL employees and subcontractors on the precautions related to the contractor's work.
- When an apparent contractor non-compliance/unsafe condition or practice poses a risk to CH2M HILL employees or subcontractors:
  - Notify the contractor safety representative.
  - Request that the contractor determine and implement corrective actions.
  - If needed, stop affected CH2M HILL work until contractor corrects the condition or practice. Notify LANTDIV, Project Manager, and HSM as appropriate.
- If apparent contractor non-compliance/unsafe conditions or practices are observed, inform the contractor safety representative. Our obligation is limited strictly to informing the contractor of our observation; the contractor is solely responsible for determining and implementing necessary controls and corrective actions.
- If an apparent imminent danger is observed, immediately warn the contractor employee(s) in danger and notify the contractor safety representative. Our obligation is limited strictly to immediately warning the affected individual(s) and informing the contractor of our observation; the contractor is solely responsible for determining and implementing necessary controls and corrective actions.

- Document all oral health and safety related communications in the project field logbook, daily reports, or other records.

1.6 Personal Protective Equipment (PPE)

Table 1-6 details the protective equipment necessary for various site tasks.

TABLE 1-6
Personal Protective Equipment

PPE SPECIFICATIONS [a]				
Task	**Level**	**Body**	**Head**	**Respirator [b]**
General site entry Surveying OE surveys and avoidance Oversight of drilling	D	Work clothes; steel-toed, leather work boots [g]; work glove.	Hardhat [c] Safety glasses Ear protection [d]	None required
Tasks requiring upgrade or downgrade for reasons presented below	C	Coveralls: Polycoated Tyvek® Boots: Steel-toed, chemical-resistant boots [g] OR steel-toed, leather work boots [g] with outer rubber boot covers Gloves: Inner surgical-style nitrile and outer chemical-resistant nitrile gloves.	Hardhat c Splash shield [c] Ear protection [d] Spectacle inserts	APR, full face, MSA Ultratwin or equivalent; with GME-H cartridges or equivalent.
Vegetation Removal	Modified D	Chaps	Face Shield	None required

Reasons for Upgrading or Downgrading Level of Protection	
Upgrade	**Downgrade**
• Request from individual performing tasks • Change in work tasks that will increase contact or potential contact with hazardous materials • Occurrence or likely occurrence of gas or vapor emission • Known or suspected presence of dermal hazards • Instrument action levels (Section 1.7) exceeded	• New information indicating that situation is less hazardous than originally thought • Change in site conditions that decreases the hazard • Change in work task that will reduce contact with hazardous materials

[a] Modifications are as indicated. CH2M HILL will provide PPE only to CH2M HILL employees.
[b] No facial hair that would interfere with respirator fit is permitted.
[c] Hardhat and splash-shield areas are to be determined by the UXOSO. UXO technicians are required to wear hard hats except when investigating suspect UXO.
[d] Ear protection should be worn when conversations cannot be held at distances of 3 ft or less without shouting.
[e] Cartridge change-out schedule is at least every 8 hours (or one work day), except if relative humidity is >85 percent, or if organic vapor measurements are > midpoint of Level C range (refer to Section 1.7)--then at least every 4 hours. If encountered conditions are different than those anticipated in this HSP, contact the HSM.
[f] Performing a task that requires an upgrade to a higher level of protection (e.g., Level D to Level C) is permitted only when the PPE requirements have been approved by the HSM, and an UXOSO or SSC qualified at that level is present.
[g] Steel-toed boots are not required during surface geophysics mapping.

1.7 Air Monitoring/Sampling

1.7.1 Air Monitoring Specifications

Table 1-7 shows relevant air monitoring specifications.

TABLE 1-7
Air Monitoring Specifications

Instrument	Tasks	Action Levels[a]		Frequency[b]	Calibration
CGI: MSA model 260 or 261 or equivalent	Drilling (well installation and soil boring)	0-10% : 10-25% LEL: >25% LEL:	No explosion hazard Potential explosion hazard Explosion hazard; evacuate or vent	Continuous during advancement of boring or trench	Daily
O_2Meter: MSA model 260 or 261 or equivalent	Drilling (Well Installation and Soil Boring)	>25%[c] O_2: 20.9%[c] O_2: <19.5%[c] O_2:	Explosion hazard; evacuate or vent Normal O_2 O_2 deficient; vent or use SCBA	Continuous during advancement of boring or trench	Daily
Detector Tube: Drager benzene specific 0.5/c (0.5 to 10 ppm range) with pre-tube, or equivalent	When positive PID indications >1 ppm	<0.5 ppm 0.5-1 ppm >1 ppm	Level D Level C Stop Work	Initially and periodically when PID/FIB >1 ppm	Not applicable
PID: Organic Vapor Monitor (OVM) with 10.6eV lamp or equivalent	All intrusive operations.	0 – 1 parts per million (ppm) >1 – 5 ppm > 5 ppm	Level D Level C Stop Work	Initially and periodically during task	Daily

[a] Action levels apply to sustained breathing-zone measurements (2 minute duration) above background.
[b] The exact frequency of monitoring depends on field conditions and is to be determined by the UXOSO SSC; generally, every 5 to 15 minutes is acceptable; more frequently may be appropriate. Monitoring results should be recorded. Documentation should include instrument and calibration information, time, measurement results, personnel monitored, and place/location where measurement is taken (e.g., "Breathing Zone/MW-3", "at surface/SB-2", etc.).

1.7.2 Calibration Specifications

Table 1-8 shows calibration specifications.

Instrument	Gas	Span	Reading	Method
PID: OVM, 10.6 or 11.8 eV bulb	100 ppm isobutylene	RF = 1.0	100 ppm	1.5 lpm reg T-tubing
PID: MiniRAE, 10.6 eV bulb	100 ppm isobutylene	CF = 100	100 ppm	1.5 lpm reg T-tubing/0.5 lpm reg, direct tubing with Tedlar BAG
CGI: MSA 260, 261, 360, or 361	0.75% pentane	N/A	50% LEL ± 5% LEL	1.5 lpm reg direct tubing

1.7.3 Air Sampling

Sampling, in addition to real-time monitoring, may be required by other Occupational Safety and Health Administration (OSHA) regulations where there may be exposure to certain contaminants. Air sampling typically is required when site contaminants include lead, cadmium, arsenic, asbestos, and certain VOCs. Contact the HSM immediately if these contaminants are encountered.

Results must be sent immediately to the HSM. Regulations may require reporting to monitored personnel.

1.8 Decontamination

The SSC must establish and monitor the decontamination procedures and their effectiveness. Decontamination procedures found to be ineffective will be modified by the SSC. The SSC must ensure that procedures are established for disposing of materials generated on the site.

1.8.1 Decontamination Specifications

Table 1-9 shows the general decontamination specifications.

TABLE 1-9
Decontamination Specifications

Personnel	Sample Equipment	Heavy Equipment
• Boot wash/rinse • Glove wash/rinse • Outer-glove removal • Body-suit removal • Inner-glove removal • Respirator removal • Hand wash/rinse • Face wash/rinse • Shower immediately • Dispose of PPE in municipal trash, or contain for disposal • Dispose of personnel rinse water to facility or sanitary sewer, or contain for offsite disposal	• Wash/rinse equipment • Solvent-rinse equipment • Contain solvent waste for offsite disposal	• Power wash • Steam clean • Dispose of equipment rinse water to facility or sanitary sewer, or contain for offsite disposal

1.8.2 Diagram of Personnel Decontamination Line

No eating, drinking, or smoking is permitted in contaminated areas and in exclusion or decontamination zones. The SSC should establish areas for eating, drinking, and smoking. Contact lenses are not permitted in exclusion or decontamination zones.

Figure 6-2 illustrates a conceptual establishment of work zones, including the decontamination line. Work zones are to be modified by the SSC to accommodate task-specific requirements.

1.9 Spill Prevention and Containment Procedures

This section establishes minimum site requirements. Subcontractors are responsible for spill prevention and control related to their operations. Subcontractors written spill prevention and control procedures must be consistent with this plan. All spills must be reported to the supervisor, site manager, and Project Manager.

1.9.1 Spill Prevention

All fuel and chemical storage areas will be properly protected from onsite and offsite vehicle traffic. Fuel storage tanks must be equipped with secondary containment. Fuel tanks must be inspected daily for signs of leaks. Accumulated water must be inspected for signs of product before discharge.

Incidental chemical products must be properly stored, transferred, and used in a safe manner. If chemical product use occurs outside areas equipped with spill control materials, adequate spill control materials must be maintained.

1.9.2 Spill Containment and Control

Spill control materials will be maintained in the support zone and at fuel storage and dispensing locations. Incidental spills will be contained with sorbent and disposed of properly. Spilled materials must be immediately contained and controlled. Spill response procedures include taking the following actions:

- Immediately warn any nearby personnel and notify the work supervisor.
- Assess the spill area to ensure that it is safe to approach.
- Activate site evacuation signal if the spill presents an emergency.
- Ensure that any nearby ignition sources are immediately eliminated.
- If it can be done safely, stop the source of the spill.
- Establish site control for the spill area.
- Use proper PPE in responding to the spill.
- Contain and control spilled material through the use of sorbent booms, pads, or other materials.

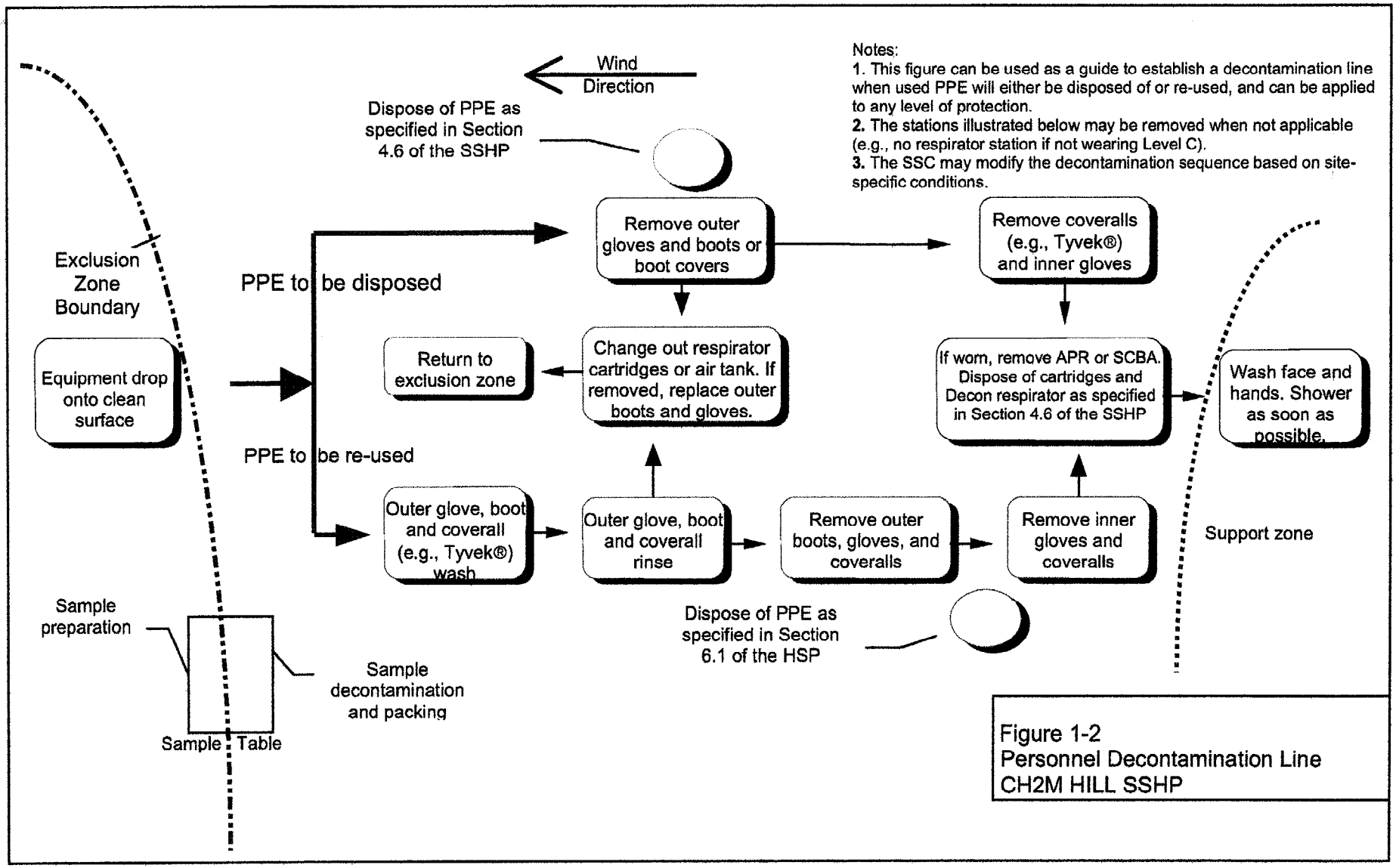


Figure 1-2
Personnel Decontamination Line
CH2M HILL SSHP

1.9.3 Spill Clean-up and Removal

All spilled material, contaminated sorbent, and contaminated media will be cleaned up and removed as soon as possible. Contaminated spill material will be drummed, labeled, and properly stored until material is disposed of. Contaminated material will be disposed of according to applicable federal, state, and local requirements. Contact the regulatory compliance person for the project or the program for assistance.

1.10 Site Control Plan

1.10.1 Site Control Procedures

- The SSC will conduct a site safety briefing (see below) before starting field activities or as tasks and site conditions change.
- Topics for briefing onsite safety include general discussion of the SSHP, site-specific hazards, locations of work zones, PPE requirements, equipment, special procedures, and emergencies.
- The SSC records attendance at safety briefings in a logbook and documents the topics discussed.
- Post the OSHA job-site poster in a central and conspicuous location in accordance with CH2M HILL SOP HS-71, OSHA Postings.
- Establish support, decontamination, and exclusion zones. Delineate with flags or cones as appropriate. Support zone should be upwind of the site. Use access control at entry and exit from each work zone.
- Establish onsite communication consisting of the following:
  - Line-of-sight and hand signals
  - Air horn
  - Two-way radio or cellular telephone if available
- Establish offsite communication.
- Establish and maintain the "buddy system."
- Initial air monitoring is conducted by the SSC in appropriate level of protection.
- The SCC is to conduct periodic inspections of work practices to determine the effectiveness of this plan: refer to Sections 1.2 and 1.3. Deficiencies are to be noted, reported to the HSM, and corrected.

1.10.2 Hazwoper Compliance Plan

Certain parts of the site work are covered by state or federal Hazwoper standards and therefore require training and medical monitoring. Anticipated Hazwoper tasks (Section 1.2.1.1) might occur consecutively or concurrently with respect to non-Hazwoper tasks. This section outlines procedures to be followed when approved activities specified in

Section 1.2.1.2 do not require 24- or 40-hour training. Non-Hazwoper-trained personnel also must be trained in accordance with all other state and federal OSHA requirements.

- In many cases, air sampling, in addition to real-time monitoring, must confirm that there is no exposure to gases or vapors before non-Hazwoper-trained personnel are allowed onsite, or while non-Hazwoper-trained staff are working near Hazwoper activities. Other data (e.g., soil) also must document that no potential exists for exposure. The HSM must approve the interpretation of these data. Refer to subsections 1.4.20 and 1.7 for contaminant data and air sampling requirements, respectively.
- When non-Hazwoper-trained personnel are at risk of exposure, the SSC must post the exclusion zone and inform non-Hazwoper-trained personnel of the following:
  - Nature of the existing contamination and its locations
  - Limitations of their access
  - Emergency action plan for the site
- Periodic air monitoring with direct-reading instruments conducted during regulated tasks also should be used to ensure that non-Hazwoper-trained personnel (e.g., in an adjacent area) are not exposed to airborne contaminants.
- When exposure is possible, non-Hazwoper-trained personnel must be removed from the site until it can be demonstrated that a potential for exposure to health and safety hazards no longer exists.
- Remediation treatment system start-ups: Once a treatment system begins to pump and treat contaminated media, the site is (for the purposes of applying the Hazwoper standard) considered a treatment, storage, and disposal facility (TSDF). Therefore, once the system begins operation, only Hazwoper-trained personnel (minimum of 24 hours of training) will be permitted to enter the site. All non-Hazwoper-trained personnel must not enter the TSDF area of the site.

1.11 Emergency Response Plan

1.11.1 Pre-Emergency Planning

The SSC will perform the applicable pre-emergency planning tasks before starting field activities and coordinates emergency response with CH2M HILL onsite parties, the facility, and local emergency service providers as appropriate. These tasks include:

- Review the facility emergency and contingency plans where applicable.
- Determine what onsite communication equipment is available (e.g., two-way radio, air horn).
- Each team will have a communication device (cell phone or two-way radio)
- Determine what offsite communication equipment is needed (e.g., nearest telephone, cell phone).

- Confirm and post emergency telephone numbers, evacuation routes, assembly areas, and route to hospital; communicate the information to onsite personnel.
- Field Trailers: Post "Exit" signs above exit doors, and post "Fire Extinguisher" signs above locations of extinguishers. Keep areas near exits and extinguishers clear.
- Review changed site conditions, onsite operations, and personnel availability in relation to emergency response procedures.
- Where appropriate and acceptable to LANTDIV, inform emergency room and ambulance and emergency response teams of anticipated types of site emergencies.
- Designate one vehicle as the emergency vehicle; place hospital directions and map inside; keep keys in ignition during field activities.
- Inventory and check site emergency equipment, supplies, and potable water.
- Communicate emergency procedures for personnel injury, exposures, fires, explosions, and releases.
- Rehearse the emergency response plan before site activities begin, including driving route to hospital.
- Brief new workers on the emergency response plan.

The S SSC will evaluate emergency response actions and initiate appropriate follow-up actions.

1.11.2 Emergency Equipment and Supplies

The SSC should mark the locations of emergency equipment on the site map and post the map, as illustrated in Table 1-10.

TABLE 1-10
Sample Supply List and Locations

Emergency Equipment and Supplies	Location
20 pound (lb) (or two 10-lb) fire extinguisher (A, B, and C classes)	Support Zone/Heavy Equipment
First aid kit	Support Zone/Field Vehicle
Eye Wash	Support & Decon Zone/Field Vehicle
Potable water	Support & Decon Zone/Field Vehicle
Bloodborne pathogen kit	Support Zone/Field Vehicle
Additional equipment (specify)	N/A

1.11.3 Incident Response

In fires, explosions, or chemical releases, actions to be taken include the following:

- Shut down CH2M HILL operations and evacuate the immediate work area.

- Notify appropriate response personnel.
- Account for personnel at the designated assembly area(s).
- Assess the need for site evacuation, and evacuate the site as warranted.

Instead of implementing a work-area evacuation, note that small fires or spills posing minimal safety or health hazards may be controlled.

1.11.4 Emergency Medical Treatment

The procedures listed below may also be applied to non-emergency incidents. Injuries and illnesses (including overexposure to contaminants) must be reported to Human Resources. If there is doubt about whether medical treatment is necessary, or if the injured person is reluctant to accept medical treatment, contact the CH2M HILL medical consultant. During non-emergencies, follow these procedures as appropriate.

- Notify appropriate emergency response authorities listed in Section 1.11.8 (e.g., 911).
- The SCC will assume charge during a medical emergency until the ambulance arrives or until the injured person is admitted to the emergency room.
- Prevent further injury.
- Initiate first aid and CPR where feasible.
- Get medical attention immediately.
- Perform decontamination where feasible; lifesaving and first aid or medical treatment take priority.
- Make certain that the injured person is accompanied to the emergency room.
- When contacting the medical consultant, state that the situation is a CH2M HILL matter, and give your name and telephone number, the name of the injured person, the extent of the injury or exposure, and the name and location of the medical facility where the injured person was taken.
- Report incident as outlined in Section 1.11.7.

1.11.5 Evacuation

- Evacuation routes and assembly areas (and alternative routes and assembly areas) are specified on the site map.
- Evacuation route(s) and assembly area(s) will be designated by the SUXOS or SSC before work begins.
- Personnel will assemble at the assembly area(s) upon hearing the emergency signal for evacuation.
- The SSC and a "buddy" will remain onsite after the site has been evacuated (if safe) to assist local responders and advise them of the nature and location of the incident.

- The SSC will account for all personnel in the onsite assembly area.
- A designated person will account for personnel at alternate assembly area(s).
- The SSC will write up the incident as soon as possible after it occurs and submit a report to the Director of Health and Safety.

6.11.6 Evacuation Signals

Table 1-11 provides some samples of possible evacuation signals.

TABLE 1-11
Evacuation Signals

Signal	Meaning
Grasping throat with hand	Emergency-help me.
Thumbs up	OK; understood.
Grasping buddy's wrist	Leave area now.
Continuous sounding of horn	Emergency; leave site now.

1.11.7 Incident Notification and Reporting

- Upon any project incident (fire, spill, injury, near miss, death, etc.), immediately notify the Project Manager and HSM. Call emergency beeper number if HSM is unavailable.
- For CH2M HILL work-related injuries or illnesses, contact and help Human Resources administrator complete an Incident Report Form (IRF). IRF must be completed within 24 hours of incident.
- For CH2M HILL subcontractor incidents, complete the Subcontractor Accident/Illness Report Form and submit to the HSM.
- Notify and submit reports to LANTDIV as required in contract.

1.11.8 Emergency Contacts (complete during project start-up)

24-hour CH2M HILL Emergency Beeper – 888/444-1226

Medical Emergency – 911 Facility Medical Response #: N/A Local Ambulance #: (787) 741-2151	CH2M HILL Medical Consultant Dr. Peter Greaney GMG WorkCare, Orange, CA (800) 455-6155 (After hours calls will be returned within 20 minutes)
Fire/Spill Emergency – 911 Facility Fire Response #:N/A Local Fire Dept #: (787) 741-2111	Local Occupational Physician N/A
Security & Police – 911 Facility Security #: Local Police #: (787) 741-2020	Corporate Director Health and Safety Name: Mollie Netherland/SEA Phone: (206) 453-5005 24-hour emergency beeper: (888) 444-1226
Utilities Emergency Water: (787) 741-2001 Gas: N/A Electric:	Health and Safety Manager (HSM) Name: Michael Goldman Phone: (770) 604-9182 (office) ext 592; (770) 335-2076 (Cell) Pager: (888) 856-9114
Site Safety Coordinator (SSC) Name: Rick Gorsira Phone: (813) 874-6522 Ext. 4313	Regional Human Resources Department Name: Mary Jo Jordan Phone: (352) 335-5877
Project Manager Name: Martin Clasen Phone: (813) 874-6522, Ext. 4307	Corporate Human Resources Department Name: John Monark/COR Phone: (303) 771-0900
Federal Express Dangerous Goods Shipping Phone: 800/238-5355 CH2M HILL Emergency Number for Shipping Dangerous Goods Phone: (800) 255-3924	Worker's Compensation and Auto Claims Sterling Administration Services Phone: (800) 420-8926 After hours: (800) 497-4566 Report fatalities and report vehicular accidents involving pedestrians, motorcycles, or more than two cars.

Federal Agency/Contact Name: DOI/Oscar Díaz Marrero Phone(787) 741-2138Phone(787) 767-8181x2953

State Agency/Contact Name: PREQB/Yarissa Martínez

Local Agency/Contact Name: MOV Public Works/Pablo Connelly Pagán Phone(787) 741-4442

Contact the Project Manager. Generally, the Project Manager will contact relevant government agencies.

Facility Alarms: N/A Evacuation Assembly Area(s): Outside of building 2016

Facility/Site Evacuation Route(s): Take Route 200 east

Hospital Name/Address: Vieques Municipal Hospital Hospital Phone #: (787) 741-2151

Directions to Hospital

For minor first aid and stabilization of personnel, proceed to local Vieques hospital. The hospital is located on route 997. Take Route 200 east (towards Isabel Segunda) for approximately 6 miles. Make a right on Route 997 going south (towards Camp García). The hospital will be ½ mile down the road on the left hand side. For extreme or life threatening emergencies, call for helicopter from NSRR (787) 865-5997. If NSRR service is not available, the Vieques hospital also has a helicopter on duty.

1.12 Approval

This SSHP has been written for use by CH2M HILL only. CH2M HILL claims no responsibility for its use by others unless that use has been specified and defined in project or contract documents. The plan is written for the specific site conditions, purposes, dates, and personnel specified, and must be amended if those conditions change.

1.12.1 Original Plan

Written By: Marty Clasen Date: 07/23/03

Approved By: Michael Goldman Date: July 30, 2003

1.12.2 Revisions

Revisions Made By: _____ Date: _____

Revisions to Plan: _____

Revisions Approved By: _____ Date: _____

1.13 Attachments

Attachment 1-1: Employee Signoff Form - Site Safety and Health Plan

Attachment 1-2: CH2M HILL HSE-91, OE SOP

Attachment 1-3: Project-Specific Chemical Product Hazard Communication Form

Attachment 1-4: Chemical-Specific Training Form

Attachment 1-5: Applicable Material Safety Data Sheets

Attachment 1-6: Lead Awareness Training

ATTACHMENT 1-1

CH2MHILL

EMPLOYEE SIGNOFF FORM

Site Safety and Health Plan

The CH2M HILL project employees and subcontractors listed below have been provided with a copy of this FSI, have read and understood it, and agree to abide by its provisions.

Project Name: RI/FS Project Number:

EMPLOYEE NAME (Please print)	EMPLOYEE SIGNATURE	COMPANY	DATE

ATTACHMENT 1-2

CH2MHILL

Ordnance Explosives (OE) Standard of Practice HSE-91

Note:

This Standard of Practice covers the entire spectrum of OE/UXO-related project activities, including investigation and removal.

For this specific project, "Initial Ordnance and Explosives Site Assessment for the SWMU 4, SWMU 6, AOC-J and Former NASD areas," the removal tasks described in Sections 4.2.2.(b), 4.2.3.(d), and 4.2.7 of this Standard of Practice will be conducted by NSRR EOD personnel and may not apply to this project.

CH2MHILL

Ordnance Explosives (OE) Standard of Practice HSE-91

Applicability and Scope

Applicability

This Standard of Practice (SOP) applies to: 1) CH2M HILL employees who enter areas known or suspected of having Ordnance Explosives (OE) and 2) CH2M HILL Safety Coordinators (SCs) and CH2M HILL EE&SBG Unexploded Ordnance Safety Officers (UXOSO) who may be responsible for providing oversight of a subcontractors OE operations. OE operations may be conducted on active, inactive, closed, transferring, or transferred ranges; former battlefields; disposal sites; or munitions manufacturing and storage sites.

1.1 Scope

This SOP provides information regarding the spectrum of hazards and issues to be addressed during each phase of a project associated with OE operations. OE hazards addressed in this SOP include exposure to Unexploded Ordnance (UXO), Chemical Warfare Material (CWM), explosives contaminated soil and groundwater, and the hazards associated with operations to locate, identify, remove, and dispose of OE. CH2M HILL employees who enter OE areas must take precautions to avoid these hazards and be aware of associated safe work practices.

As described in the "Subcontractor, Contractor, and Owner" SOP HSE-55, responsibilities for health, safety and environment (HS&E) are expressly defined through the subcontract terms and conditions, and CH2M HILL's HS&E practices in the field are determined based on these defined responsibilities. Consistent with HSE-55, the subcontractor must determine how to operate safely and in compliance with applicable HS&E regulations and industry standards, and how to correct deficiencies. CH2M HILL employees shall not direct the means and methods of OE operations nor direct the details of corrective actions.

Regulatory Review

OE projects are often complex and have a myriad of regulatory requirements to ensure safety. Support for determining the governing laws and regulations for any specific OE project must be reviewed by the EE&SBG UXOSO to ensure compliance and safety.

Department of Defense (DOD) Ammunition and Explosives Safety Standards, DOD 6055.9-STD, establishes uniform safety standards applicable to ammunition and explosives, to associated personnel and property, and to unrelated personnel and property exposed to the potential damaging effects of an accident involving ammunition and explosives during their development, manufacturing, testing, transportation, handling, storage, maintenance, demilitarization, and disposal.

The U.S. Environmental Protection Agency (EPA) regulates the disposal of military munitions and waste containing military munitions through the Military Munitions Rule (RCRA; 40 CFR part 266, subpart M). The rule 1) identifies when conventional and chemical military munitions become a solid waste and 2) provides criteria for storage and transportation of such waste, including a conditional exemption if the munitions are managed under DOD rules.

Project Planning

Training Requirements

CH2M HILL employees and subcontractors who work on projects that involve OE must complete the following training:

- 40-hour hazardous waste comprehensive course with training in hazard recognition and basic health and safety issues, as required by the occupational safety and health regulations contained in 29 CFR 1910.120(e)
- Annual 8-hour hazardous waste refresher course
- Hazardous waste supervisory training as specified in 29 CFR 1910.120(e) [only required for management and supervisors]
- All UXO personnel will be graduates of one of the following: U.S. Army Bomb Disposal School, Aberdeen Proving Ground, MD; U.S. Naval Explosive Ordnance Disposal (EOD) School, Indian Head, MD; U.S. Naval EOD School, Eglin Air Force Base, FL; EOD Assistants Course, Redstone Arsenal AL; EOD Assistant Course at Eglin Air Force Base, FL; or a U.S. DOD-certified equivalent course

The EE&SBG UXOSO can provide assistance in reviewing subcontractor personnel qualifications.

Medical Surveillance Requirements

All CH2M HILL employees who work on OE sites must be on a medical surveillance program consisting of a baseline health assessment that includes a medical and occupational history review, blood and urine tests for contaminants of interest, electrocardiogram, slit-lamp corneal examination, pulmonary function tests, chest x-ray, respiratory fit test, and a general physical examination that includes hearing and vision.

Employees who terminate employment and who have worked at OE project sites may be required to undergo an exit examination equivalent to the baseline health assessment.

Subcontractors are responsible for ensuring that their employees receive medical surveillance as required.

Drug Abuse Surveillance Requirements

CH2M HILL employees who perform OE operations and oversight are subject to the provisions contained in HSE-76.

Competent Person Requirements

OE/UXO subcontractors are responsible for providing a competent person to oversee OE operations. A competent person may be a Senior UXO Supervisor, UXO Safety Officer, UXO Quality Control Specialist, or a UXO Technician III. The competent person must meet the following minimum qualification requirements:

- Be a graduate of either of one of the following: U.S. Army Bomb Disposal School, Aberdeen Proving Ground, MD; U.S. Naval Explosive Ordnance Disposal (EOD) School, Indian Head, MD; U.S. Naval EOD School, Eglin Air Force Base, FL; EOD Assistants Course, Redstone Arsenal Alabama; EOD Assistant Course at Eglin Air Force Base, FL; or a U.S. DOD-certified equivalent course

- Have at least 10 years of combined active duty military EOD and contractor UXO experience
- Have experience in OE clearance operations and supervising personnel

CH2M HILL competent person requirements are the same as for a subcontractor.

1.2 Safety Equipment

OE subcontractors are responsible for providing all personal protective equipment (PPE) necessary for their employees. CH2M HILL will provide PPE only for its own employees. Other safety equipment will be provided as delineated in the subcontract and referenced documents. The EE&SBG UXOSO must review subcontractor work plans and health and safety plans to ensure that appropriate safety equipment has been included to meet the scope of work requirements.

1.3 Subcontractor Selection

OE subcontractors are selected as described in the "Subcontractor, Contractor, and Owner" SOP HSE-55. The "Subcontractor Safety Procedure Criteria - OE Operations" found in Attachment 1 provides the minimum criteria for OE operations. Additional criteria may be developed dependent upon the specific OE scope of work requirements for the subcontractor. These criteria shall be used by the CH2M HILL EE&SBG UXOSO to review subcontractor OE procedures submitted when oversight is required by HSE-55.

1.4 Planning Activities

Assistance for planning OE operations is available from the CH2M HILL EE&SBG UXOSO for planning and executing OE support for Hazardous Toxic Radiological Waste (HTRW) support activities, construction support activities, OE response actions, CWM activities, explosive contaminated soils, and ordnance demilitarization. The following types of support may be needed for OE operations:

- On a HTRW site with known or suspected OE, UXO support refers to the anomaly avoidance techniques implemented to avoid any potential surface UXO and any subsurface anomalies.
- On a construction site with known or suspected OE, UXO support is provided by qualified UXO personnel during construction activities. The level of UXO support required is dependent on the probability of encountering UXO, as determined on a project-by-project basis.
- OE response actions in which location, identification, excavation, removal, and disposal of UXO is accomplished require qualified UXO personnel, including a Senior UXO Supervisor, UXO Safety Officer, and UXO Quality Control Specialist to provide oversight for UXO Teams performing operations.
- On an OE site that has OE contamination of soils and/or groundwater, UXO support may include both anomaly avoidance techniques and OE construction support for excavation and/or treatment of OE contaminated soil and groundwater.
- On ordnance demilitarization and CWM projects, OE support may be needed for identification, handling, disassembly, processing, transportation, and treatment or disposal of munition components.
- On projects where OE waste (OEW) is transported or disposed off-range, the UXO and Environmental Compliance Coordinator (ECC) may assist in identifying the applicable regulations and permits required.

- On projects where Ordnance Related Scrap (ORS) or inert ordnance is recovered and processed for disposal as scrap, UXO and ECC support may determine if incineration and certification is required, along with any permitting requirements for portable incinerator operation.

The CH2M HILL EE&SBG UXOSO or EE&SBG UXO Quality Control Specialist shall verify subcontractor training and current medical examinations prior to the start of field operations.

Definitions

3.1 Active Range. A military range that is currently in use and being regularly used for range activities.

3.2 Anomaly. Any item that is seen as a subsurface irregularity after geophysical investigation. This irregularity should deviate from the expected subsurface ferrous and nonferrous material at a site.

3.3 Anomaly Avoidance. Techniques employed by EOD or UXO personnel at sites with known or suspected OE to avoid any potential surface UXO or subsurface anomalies. This usually occurs at mixed hazard sites when HTRW investigations must occur prior to execution of an OE removal action. Intrusive anomaly investigations are not authorized during ordnance avoidance operations.

3.4 Chemical Warfare Materials (CWM). An item configured as a munition containing a chemical substance that is intended to kill, seriously injure, or incapacitate a person through its physiological effects. Also includes V- and G-series nerve agents, H-series blister agent, and lewisite in other-than-munition configurations. Due to their hazards, prevalence, and military-unique application, chemical agent identification sets (CAIS) are also considered CWM. CWM does not include: riot control agents, chemical herbicides, smoke and flame producing items, or soil, water, debris, or other media contaminated with a chemical agent.

3.5 OE Construction Support. Support provided by qualified UXO personnel during construction activities at potential OE sites to ensure the safety of construction personnel from the harmful effects of UXO. When a determination is made that the probability of encountering UXO is low (current or previous land use leads to a determination that OE may be present), a two person UXO team will stand by in case the construction contractor encounters a suspected UXO. When a determination is made that the probability of encountering a UXO is moderate to high (current or previous land use leads to a determination that OE was employed or disposed of in the parcel of concern, e.g., open burn and open detonation areas), UXO teams are required to conduct subsurface UXO clearance for the known construction footprint either in conjunction with the construction contractor or prior to construction.

3.6 EOD Personnel. EOD personnel are those active duty military individuals performing EOD operations.

3.7 Explosive Ordnance Disposal (EOD). EOD includes the detection, identification, field evaluation, rendering safe, and final disposal of OE.

3.8 Explosive Safety Submission (ESS). The document that serves as the specifications for conducting work activities at the project. The ESS details the scope of the project, the planned work activities, and potential hazards and the methods for their control.

3.9 Explosive Soil. Refers to mixtures of explosives in soil, sand, clay, or other solid media at concentrations such that the mixture itself is explosive.

(a) The concentration of a particular explosive in soil necessary to present an explosion hazard depends on whether an explosive is classified as "primary" or "secondary."

(b) Primary explosives are those extremely sensitive explosives (or mixtures thereof) that are used in primers, detonators, and blasting caps. They are easily detonated by heat, sparks, impact, or friction. Examples of primary explosives include lead azide, lead styphnate, and mercury fulminate.

(c) Secondary explosives are bursting and boostering explosives (i.e., they are used as the main bursting charge or as the booster that sets off the main bursting charge). Secondary explosives are much less sensitive than primary explosives.

(d) Soil containing 10 percent or more by weight of any secondary explosive mixture of secondary explosives is considered "explosive soil."

(e) Soil containing propellants (as opposed to primary or secondary high explosives) may also present explosion hazards.

3.10 Inactive Range. A military range that is not currently being used, but that is still under military control and considered by the military to be a potential range area, and that has not been put to a new use that is incompatible with range activities.

3.11 Intentional Detonation. An intentional detonation is a planned, controlled detonation.

3.12 Intrusive Activity. An activity that involves or results in the penetration of the ground surface at an area known or suspected to contain OE. Intrusive activities can be of an investigative or removal action nature.

3.13 Maximum Credible Event. The worst single event that could occur at any time, with maximum release of a chemical agent from a munition, container, or process as a result of unintended, unplanned, or accidental occurrence.

3.14 Most Probable Event (MPE). The most likely event, as a result of an accidental, unplanned, or unintended detonation of an item of ordnance, that could occur during OE activities. The event must be realistic with reasonable probability of occurrence.

3.15 Most Probable Munition (MPM). The OE item that has the greatest hazard distance based on calculations of the explosion effects of the OE items anticipated to be found at a site. Typically, the MPM is the OE item with the greatest fragmentation or overpressure distance based on the type of OE items that were historically used at the site.

3.16 Military Munitions. All ammunition products and components produced or used by or for the U.S. DOD or the U.S. Armed Services for national defense and security, including military munitions under the control of the DOD, the U.S. Coast Guard, the U.S. Department of Energy (DOE), and the National Guard personnel. The term military munitions includes: confined gases, liquid, and solid propellants, explosives, pyrotechnics, chemical and riot control agents, smokes, and incendiaries used by DOD components, including bulk explosives and chemical warfare agents, chemical munitions, rockets, guided and ballistic missiles, bombs, warheads, mortar rounds, artillery ammunition, small arms ammunition, grenades, mines, torpedoes, depth charges, cluster munitions and dispensers, demolition charges, and devices and components thereof.

3.17 Military Range. Designated land and water areas set aside, managed, and used to conduct research on, develop, test, and evaluate military munitions and explosives, other ordnance

or weapons systems, or to train military personnel in their use and handling. Ranges include firing lines and positions, maneuver areas, firing lanes, test pads, detonation pads, impact areas, and buffer zones with restricted access and exclusionary areas.

3.18 Non-Stockpile Chemical Warfare Materials. CWM (defined above) that is not included in the chemical stockpile. Non-stockpile CWM is divided into five categories:

(1) Buried CWM.

(2) Recovered chemical weapons (items recovered during range clearing operations, from chemical burial sites, and from research and development testing).

(3) Former chemical weapon production facilities.

(4) Binary chemical weapons.

(5) Miscellaneous CWM (unfilled munitions and devices and equipment specially designed for use directly in connection with employment of chemical weapons).

3.19 Ordnance and Explosives (OE) consists of:

(1) Ammunition, ammunition components, chemical or biological warfare materials that have been abandoned, expelled from demolition pits or burning pads, lost, discarded, buried or fired. Such ammunition, ammunition components, and explosives are no longer under accountable record control of any DOD organization or activity.

(2) Explosive Soil. See definition under "explosive soils."

(3) OE market includes: Unexploded Ordnance (UXO), Chemical Weapons Materials (CWM), OE Contaminated Soils and Groundwater, Range Maintenance, Ordnance Demilitarization (Demil), and Demining (DM).

3.20 Quantity-Distance (QD). The quantity of explosives material and distance separations that provide defined types of protection. These relationships are based on levels of risk considered acceptable for the stipulated exposures and are tabulated in the appropriate Q-D tables provided in DOD 6055.9-STD. Separation distances are not absolute safe distances but are relative protective safe distances. Greater distances than those shown in the Q-D tables shall be used whenever possible.

3.21 Removal Action. The cleanup of OE from the environment to include the disposal of removed material. The term includes, in addition, without being limited to, security fencing or other measures to prevent, minimize, or mitigate damage to the public health or welfare or the environment.

3.22 Response Action. Action taken instead of or in addition to a removal action to prevent or minimize the release of OE so that it does not cause substantial danger to present or future public health or welfare or the environment.

3.23 Senior UXO Supervisor (SUXOS). Supervises all contractor onsite UXO activities. This individual must be a graduate of the U.S. Army Bomb Disposal School, Aberdeen proving Ground, MD, or the U.S. Naval EOD School, Indian Head, MD. This individual must have at least 15 years of combined active duty military EOD and contractor UXO experience, to include at least 10 years in supervisory positions.

3.24 Unintentional Detonation. A detonation not planned in advance.

3.25 Unexploded Ordnance (UXO). Military munitions that have been primed, fuzed, armed, or otherwise prepared for action, and have been fired dropped, launched, projected or placed in such a manner as to constitute a hazard to operations, installation, personnel, or material and remain unexploded either by malfunction, design, or any other cause.

3.26 UXO Personnel. Contractor personnel who have completed specialized military training in EOD methods and have satisfactorily performed the EOD function while serving in the military. Various grades and contract positions are established based on skills and experience.

3.27 UXO Safety Officer (UXOSO). Contractor personnel with the responsibility of enforcing the contractor's SSHP. This individual must, therefore, be in the field whenever possible to observe operations. This individual must have the same minimum qualifications as the UXO Technician III. In addition, this individual must have the specific training, knowledge, and experience necessary to implement the SSHP and verify compliance with applicable safety and health requirements.

3.28 UXO Technician III. Supervises a UXO team. This individual must be a graduate of the U.S. Army Bomb Disposal School, Aberdeen Proving Ground, MD, the U.S. Naval EOD School, Indian Head, MD, or U.S. Naval EOD School, Elgin Air Force Base, FL, or a DOD-equivalent certified course. This individual must have a minimum of 10 years of military EOD or contractor UXO experience.

3.29 UXO Technician II. This individual must be a graduate of the U.S. Army Bomb Disposal School, Aberdeen Proving Ground, MD, the U.S. Naval EOD School, Indian Head, MD, or U.S. Naval EOD School, Elgin Air Force Base, FL, or a DOD-equivalent certified course. This individual must have a minimum of 5 years of military EOD or contractor UXO experience.

Project Execution

Safe Work Practices

The requirements of this section are to be followed by CH2M HILL employees who enter OE exclusion zones, regardless of the company performing OE operations. These requirements also pertain to OE subcontractor personnel when CH2M HILL is providing oversight.

Regulations/Industry Standards

As described in the "Subcontractor, Contractor, and Owner" SOP HSE-55, CH2M HILL's project EE&SBG UXOSO may be required to provide oversight of an OE subcontractor. OE subcontractors retain control over their practices, and CH2M HILL's oversight does not relieve them of their own responsibility for effective implementation and enforcement of HS&E requirements. The following subsections provide the minimum regulatory and industry standard requirements pertaining to OE operations.

General Safety Concerns and Procedures

(a) OE operations will not be conducted until a complete plan for the site is prepared and approved by the CH2M HILL EE&SBG UXOSO. These plans will be based upon limiting exposure to the minimum number of personnel, for the minimum amount of time, to the least amount of OE consistent with safe and efficient operations.

(b) Only UXO qualified personnel will perform OE procedures. Non-UXO personnel may be used to perform OE-related procedures when supervised by a UXO Technician III. All personnel engaged in field operations will be thoroughly trained and capable of recognizing the specific hazards of the procedures being performed. To ensure that these procedures are performed to standards, all field personnel will be under the direct supervision of a UXO Technician III.

(c) Personnel who will be handling OE items will not wear outer or inner garments having static electricity-generating characteristics. Materials made of 100 percent polyester, nylon, silk, and wool are highly static producing.

(d) UXO Technicians are required to wear hard hats except when investigating suspect UXO. Hard hats may create an unsafe condition by falling off of the head of a UXO technician at a critical moment. In the event of the accidental detonation of a UXO (the worst case accident scenario), the hard hat will not protect the UXO technician from fragments and may worsen the injury by reflecting fragments into the head of the technician. This is consistent with safety guidance from the U.S. Army Corps of Engineers OE Center of Excellence. Also, protective shoes worn by personnel performing UXO operations should be constructed of nonferrous materials (e.g., fiberglass) to prevent interference with sensitive geophysical instruments.

(e) Prior to any action being performed on an ordnance item, all fuzing will be positively identified. This identification will consist of fuze type by function, condition (armed or unarmed), and the physical state/condition of the fuze, i.e., burned, broken, parts exposed/sheared, etc.

OE Safety Precautions

(a) Every effort will be made to identify a suspect OE item. Under no circumstances will any OE be moved in an attempt to make a positive identification. The OE item will be visually examined for markings and other external features such as shape, size, and external fittings. If an unknown OE item is encountered, the CH2M HILL EE&SBG UXOSO will be notified immediately. The following are additional considerations for the safe handling of OE items:

(1) Projectiles containing base detonating (BD) fuzes are to be considered armed if the round is fired.

(2) Arming wires and pop-out pins on unarmed fuzes should be secured prior to any movement.

(3) Do not depress plungers, turn vanes, rotate spindles, levers, setting rings, or other external fittings on OE items. Such actions may arm or activate the OE.

(4) Do not attempt to remove any fuzes from the OE. Do not dismantle or strip components from any OE items unless the item is included in the scope of work (SOW).

(5) UXO personnel are not authorized to inert any OE items found onsite unless it is a part of the SOW.

(6) OE/UXO items will not be taken from the site as souvenirs/training aids.

(7) Civil War ordnance will be treated as any other OE.

(b) Prior to entering U.S. Army-controlled areas/ranges contaminated with Improved Conventional Munitions (ICM), an approved Department of the Army (DA) wavier must be obtained.

(c) Any time suspect chemical warfare material (CWM) is encountered during conventional OE site activities, all work will immediately cease. Project personnel will withdraw along cleared paths upwind from the discovery. A team consisting of two personnel will secure the area to prevent unauthorized access. Personnel should position themselves as far upwind as possible while still maintaining security of the area. The local point of contact designated in the Work Plan will be immediately notified.

(d) Avoid inhalation and skin contact with smoke, fumes, and vapors of explosives and other related materials.

(e) Consider OE items that have been exposed to fire and detonation as extremely hazardous. Chemical and physical changes may have occurred to the contents, which might render them more sensitive than their original state.

(f) Do not rely on the color coding of OE for positive identification. Munitions having incomplete or improper color codes have been encountered.

(g) Avoid approaching the forward area of an OE item until it can be determined whether or not the item contains a shaped charge. The explosive jet, which is formed during detonation, can be lethal at great distances. Assume that all shaped charge munitions contain piezoelectric (PZ) fuzing system until identified. PZ is extremely sensitive. It can function at the slightest physical change and can remain hazardous for an indefinite period of time.

(h) Approach an unfired rocket motor from the side at a 45-degree angle. Accidental ignition can cause a missile hazard and hot exhaust.

(i) Do not expose unfired rocket motors to any electromagnetic radiation (EMR) sources.

(j) Consider an emplaced landmine armed until proven otherwise. It may be intentionally booby-trapped to deceive.

(k) Assume that practice OE contains a live charge until it can be determined otherwise. Expended pyrotechnic and practice devices can contain red or white phosphorous residue. Due to incomplete combustion, the phosphorous may re-ignite if the crust is broken and exposed to air.

(l) Do not approach a smoking white phosphorous (WP) munition. Burning WP may detonate the explosive burster charge at anytime.

(m) Foreign ordnance was returned to the United States for exploitation and subsequent disposal. Every effort must be made to research the applicable documentation and publications prior to commencement of a project.

OE Storage

(a) During OE projects, explosive storage falls into two categories, on-DOD installations and off-DOD installations.

(b) For On-DOD installations the provisions of DOD 6055.9-STD will be followed.

(c) In the event the installation does not have an existing storage facility, the provisions of DOD 6055.9-STD will apply.

(d) For Off-DOD installations, establish a temporary explosive storage area that will meet all local, state, and 27 CFR, Bureau of Alcohol Tobacco, and Firearms (BATF) requirements and as

much of DOD 6055.9-STD as is practical to implement. The establishment of a temporary explosive storage area must meet the following requirements:

(1) The area will, if possible, meet the inhabited building and public traffic route distances specified in DOD 6055.9-STD. If the distances are less than required by the DOD guidance, a proposed barricading plan to protect the public from accidental detonation must be developed and reviewed by the CH2M HILL Corporate UXOSO.

(2) Magazines must meet the requirements of the BATF regulations, and each magazine must have a Net Explosive Weight (NEW) established for the explosives to be stored.

(3) Each magazine must be grounded as specified in NFPA 780 and must meet the intermagazine distances as defined in the DOD guidance.

(4) A physical security survey will be conducted to determine if fencing or guards are required. This survey will be coordinated through the CH2M HILL EE&SBG UXOSO and local law enforcement agencies.

(5) A fire plan for either on- or off-installation explosive storage areas will be prepared and coordinated through the CH2M HILL EE&SBG UXOSO and the local fire department. All magazines will have placards.

(e) OE Waste (OEW) may be stored: 1) in RCRA regulated units (i.e., tanks, containers, containment buildings, etc.) as described in HSE-80; 2) in military magazines conforming to DDESB standards (as described above); or 3) under the MMR conditional exemption (40 CFR 266.205). The MMR conditional exemption applies to military non-chemical munitions, and the following procedures must be met:

(1) Follow DDESB requirements for storage.

(2) Notify EPA of the location of the unit within 90 days of when storage unit first is used for waste munitions storage.

(3) Notify EPA within 24 hours of any loss or theft of munitions from the storage area.

(4) Inventory wastes annually, conduct inspections quarterly and keep records for at least three years.

(5) Limit access to the area to appropriately trained and authorized personnel.

OE Transportation

In the event that OE items must be transported offsite, the provisions of NAVSEA SW020-AC-SAF-010 state and local laws must be followed. These additional considerations are provided for the safe transport of OE items:

(a) Do not transport WP munitions unless they are immersed in water, mud, or wet sand.

(b) If loose pyrotechnic, tracer, flare, or similar mixtures are to be transported, they will be placed in #10 mineral oil or equivalent to minimize the fire and explosion hazards.

(c) Incendiary loaded munitions should be placed on a bed of sand and covered with sand to help control the burn if a fire should start.

(d) If a base-ejection projectile must be transported to a disposal area, the base will be oriented in the vehicle so that it is parallel to the rear axle. This will afford maximum protection for the personnel operating the vehicle.

(e) OE with exposed hazardous fillers such as high explosives (HE), will be placed in appropriate containers with packing materials to prevent migration of the hazardous fillers. Padding should be added to protect the exposed filler from heat, shock, and friction.

OE Exclusion Zone Operations

On OE project sites, it is the responsibility of the UXOSO to establish the exclusion zone for each UXO team. This exclusion zone should not be confused with the safe separation distance that is maintained between teams.

(a) The purpose of the exclusion zone is for the protection of nonessential project personnel and the public from blast overpressure and fragmentation hazards. There are two criteria for calculating exclusion zones:

(1) Intentional Detonations. When destroying ordnance, both the hazards from fragmentation and overpressure must be considered. The minimum separation distances in DOD 6055.9-STD will also be used unless otherwise stated.

(2) Unintentional Detonations. If the identification of OE on an OE site is unknown, the minimum separation specified in DOD 6055.9-STD, Chapter 5, Paragraph C5.5.4, will be used to establish the exclusion zones.

(b) When multiple teams are working onsite, a safe separation distance will be established. The minimum distance maintained between teams will never be less than 200 ft, the K50 overpressure distance, or the lethal fragrant distance. The one that is greater will be used.

(c) While OE operations are being conducted, only personnel essential for the operation will be allowed in the exclusion zone. When nonessential personnel enter the exclusion zone, all OE operations will cease. In addition to this work stoppage, the following actions will be accomplished:

(1) The individuals must receive a safety briefing and sign the visitors' log prior to entering the zone.

(2) The individuals will be escorted by a UXO qualified individual.

(3) All OE operations will cease within the radius of the exclusion zone for the areas to be visited.

(d) All personnel working within the exclusion zone must comply with the following:

(1) There will be no smoking within the exclusion zone, except in areas designated by the UXOSO.

(2) There will be no open fires for heating or cooking within the exclusion zone, except where authorized by the UXOSO.

(3) During magnetometer operations, workers will have no metal parts in or on their shoes that would cause the magnetometer to present false indications.

OE Excavation Operations

(a) Hand excavation is the most reliable method for uncovering OE, provided the item is near the surface. Hand excavation exposes personnel to the hazard of detonation for longer periods of time than any other method. Taking this into consideration, only UXO qualified personnel will be used to accomplish this task.

(b) Earth-Moving Machinery (EMM) may be used to excavate overburden from suspected OE. EMM will not be used to excavate within 12 inches of a suspected OE. Once the EMM is within 12 inches of the OE, the excavation will be completed by hand excavation methods. Personnel who are not UXO qualified may operate EMM only when supervised by a UXO Technician III.

(1) If more than one EMM is to be used onsite, the same minimum separation distances required for multiple work teams applies.

(2) EMM operations will be conducted within the guidelines of HSE-32 "Excavations."

(c) Excavation operations, whether by hand or EMM, will employ a step-down or offset access method. Under no circumstances will any excavation be made directly over the suspected OE.

OE Disposal Operations

To avoid MMR regulation, all demolition operations will be conducted on-range in accordance with TM/EODB 60A 1-1-31. Any deviation from this policy must be approved by the UXOSO and the Environmental Compliance Coordinator (ECC). The following are on-range disposal procedures.

(a) As a general rule, all demolition operations will be accomplished by use of shock tubing or electrical means to assure maximum safety. There are exceptions to this requirement in situations where static electricity of EMR hazards are present.

(b) The only acceptable disposal method is the one stated in the appropriate TM/EODB 60-series manual for specific ordnance types. Any commercial explosives being used will be equivalent to the military explosive required for the disposal operation.

(c) If a situation dictates, protective measures to reduce shock, blast overpressure, and fragmentation will be taken. The CH2M HILL EE&SBG UXOSO will assist in any design work and must review and approve all proposed protective works. As a minimum requirement, all demolition shots will be tamped with clean earth or sand. In accordance with DOD 6055.9-STD the following separation distances will be observed unless otherwise directed:

(1) Minimum separation distance for nonfragmenting explosive materials will be no less than 1,250 ft.

(2) Minimum separation distance for fragmenting explosive ordnance will be no less than 2,500 feet. For bombs and projectiles with a diameter of 5 inches or greater, use a minimum distance of 4,000 ft.

(3) Ordnance items with lifting lugs, strong backs, base plates, etc., will be oriented away from personnel, as fragments from these items tends to travel farther than normal.

(d) Once demolition operations are completed, a thorough search of the demolition area will be conducted with a magnetometer to ensure a complete disposal was accomplished.

(e) Inert ordnance will not be disposed of for scrap until the internal fillers/voids have been exposed and unconfined. Heat generated during the reclamation process can cause the inert fillers, moisture, or air to expand and burst the sealed casings. In this situation, Oil Well Perforators can be used for venting these ordnance items that require demilitarization.

(f) Inert ordnance to be disposed of as scrap may require certification by the UXOSO and a government representative. This may require further treatment by operation of a portable incinerator, depending on local requirements and acceptance criteria. The UXOSO and ECC will determine if certification and incineration is necessary, along with any permitting requirements during project planning.

4.2.8 OEW Disposal

When the used or fired munition is managed off-range (i.e., transported off-range and stored, reclaimed, treated or disposed) or disposed of on-range (i.e., buried without treatment), it is subject to regulation as a solid waste under RCRA. This means it may also be subject to regulation as a hazardous waste. Also, munitions that land off-range, and that are not promptly retrieved, are solid wastes. Table 4-1 describes how solid wastes may be characterized as hazardous in these situations. All characterization must be based on field observations by the EE&SBG UXOSO, who is trained in the proper identification of waste ordnance items and meet the requirements for an "emergency response expert" under RCRA. In the event the OEW is regulated as hazardous waste, refer to the Hazardous Waste SOP, HSE-80 for RCRA hazardous waste management requirements.

TABLE 4-1
Waste Characterization

Item	Characterization	Waste Code
Uncontaminated Metal Debris	If visual inspection determines if item does not contain waste residue, waste is non-hazardous scrap metal, excluded from RCRA regulation under 40 CFR 261.6(a)(3). Waste may be subject to further incineration and certification requirements.	None
Contaminated Metal Debris	If visual inspection determines item contains hazardous waste residue, manage as potential hazardous waste.	Potential D003 and/or D008
Ordnance Items Less than 0.5 Caliber	Small-arms ammunition is not considered reactive hazardous waste in accordance with EPA policy (November 30, 1984 Memorandum, John Skinner, OSWER Director).	None
Ordnance Items Greater than 0.5 Caliber	Untreated UXO presumed to be reactive hazardous waste using generator knowledge under 40 CFR 261.23.	D003
Ordnance Items Greater than 0.5 Caliber w/Lead Projectiles	Ordnance containing lead projectiles will be presumed to be toxic hazardous waste under 40 CFR 261.24.	D008

Forms/Permits

(a) **Type-33 User of High Explosives License/Permit** issued by the BATF? is required for the purchase, storage, and use of HE in support of OE operations, construction projects, and demolition and disposal (D&D) projects. Written authorization designating the individuals who can purchase, store, or use explosives must be included in the site-specific work plans.

(b) **State and Local Explosive Permits** may be required for the purchase, storage, and use of HE in support of OE operations, construction projects, and D&D projects.

4.4 Self-Assessment Checklists

The "HS&E Self-Assessment Checklist – OE Operations" found in Attachment 2 is provided as a method of verifying compliance with established safe work practices, regulations, and industry standards pertaining to OE operations. CH2M HILL's project UXOSO/EE&SBG UXOSO shall use this checklist when: 1) CH2M HILL employees are potentially exposed to hazards associated with OE operations, and/or 2) CH2M HILL oversight of an OE subcontractor is required. The EE&SBG UXOSO shall specify the frequency in which this checklist shall be completed and provide this information in the project's written safety plan. Completed checklists shall be sent to the EE&SBG UXOSO for review. The EE&SBG UXOSO shall assist the Site UXOSO in resolving any deficiencies identified during the self-assessment.

Attachments

Attachment 1: Subcontractor Safety Procedure Criteria for OE Operations

Attachment 2: H&S Self-Assessment Checklist for OE Operations

Ordnance Explosives (OE)

Standard of Practice HSE-91

Attachment 1: Subcontractor Safety Procedure Criteria for OE Operations

Pending. Contact the CH2M HILL EE&SBG UXO Safety Officer for assistance.

Attachment 2: H&S Self-Assessment Checklist for OE Operations

Contact the CH2M HILL EE&SBG UXO Safety Officer for assistance.

ATTACHMENT 1-3

CH2MHILL

Project-Specific Chemical Product Hazard Communication Form

This form must be completed prior to performing activities that expose personnel to hazardous chemicals products. Upon completion of this form, the SSC shall verify that training is provided on the hazards associated with these chemicals and the control measures to be used to prevent exposure to CH2M HILL and subcontractor personnel. Labeling and MSDS systems will also be explained.

Project Name: NASD Vieques

Project Number:

MSDSs will be maintained at the following location(s):

No chemicals are expected to be used as part of the OE surveys and removals. If chemicals are brought to the site for use during the investigation, the chemicals will be added to this form and the appropriate MSDS Sheets will be attached to this plan.

Hazardous Chemical Products Inventory

Chemical	***Quantity***	Location	MSDS Available	***Container labels***	
				Identity	Hazard

Refer to SOP HS-05 Hazard Communication for more detailed information.

ATTACHMENT 1-4

CH2MHILL

CHEMICAL-SPECIFIC TRAINING FORM

Location:	Project # :
HCC:	Trainer:

TRAINING PARTICIPANTS:

NAME	SIGNATURE	NAME	SIGNATURE

REGULATED PRODUCTS/TASKS COVERED BY THIS TRAINING:

The HCC shall use the product MSDS to provide the following information concerning each of the products listed above.

☐ Physical and health hazards

☐ Control measures that can be used to provide protection (including appropriate work practices, emergency procedures, and personal protective equipment to be used)

☐ Methods and observations used to detect the presence or release of the regulated product in the workplace (including periodic monitoring, continuous monitoring devices, visual appearance or odor of regulated product when being released, etc.)

Training participants shall have the opportunity to ask questions concerning these products and, upon completion of this training, will understand the product hazards and appropriate control measures available for their protection.

Copies of MSDSs, chemical inventories, and CH2M HILL's written hazard communication program shall be made available for employee review in the facility/project hazard communication file.

ATTACHMENT 1-5: APPLICABLE MATERIAL SAFETY DATA SHEETS

To be inserted at project start up.

ATTACHMENT 1-6: LEAD AWARENESS

Lead Exposure Training Instructions

This module was designed for employees who work in areas with percent levels of inorganic lead or areas where there is a potential lead exposure above the action level of 30 $\mu g/m^3$.

Lead Exposure Training Program

The OSHA lead standard (29 CFR 1910.1025) requires employers to provide lead training for those employees who may be exposed to inorganic lead above the action level of 30 $\mu g/m^3$. This training program satisfies this OSHA requirement and is provided to assist employees in recognizing lead exposure hazards and understanding the procedures to be followed to minimize exposure.

Objectives

- Inform employees of the possible adverse health effects of lead exposure
- Inform employees of the regulatory requirements when working with or around lead
- Identify how lead exposures could occur on CH2M HILL projects

How to complete this training

Employees are required to read the training materials that follow and complete a short quiz. The training materials must be read thoroughly and understood before completing the quiz; you will have only one chance at answering each question.

Quiz scores will automatically be sent to the Health and Safety Training Administrator. A minimum score of 70 percent must be obtained to receive credit for this training. If a passing score is obtained, the H&S Training Administrator will issue you a certificate of completion. If a passing score is not obtained, you are required to contact your regional health and safety program manager to discuss the training material directly.

Lead Exposure Training

1. Uses And Occurrences

Lead is a well-known naturally-occurring metal found in the earth's crust, often associated with silver and zinc. It has had a variety of uses since antiquity, but its greatest use today is in car batteries. It was formerly used in gasoline, water pipes, pottery glazes, paint, solder, and as metal alloy. It currently has a variety of other uses such as radiation shielding, as vibration dampening material, in explosives, bullets, magnets, and in electronic equipment. It is also a common contaminant at hazardous waste sites.

2. Physical Characteristics

Lead exist as the familiar soft, dull gray metal, as a white or red solid as lead oxide, a gray or black solid as lead sulfide (galena), a white solid as lead sulfate, all which are insoluble in water. There are numerous other forms of inorganic lead. The organic forms, tetraethyl lead and tetramethyl lead, used in the past in fuels, are flammable colorless liquids also insoluble in water.

3. Toxicity and Hazards

Lead is a highly toxic substance that has a variety of adverse health effects from both chronic and acute exposure. An acute exposure to high levels of lead can cause a brain condition known as encephalopathy which can lead to death in a few days. The more common chronic exposure can also cause brain damage, blood disorders (anemia), kidney damage, damage to the reproductive system of both men and women and toxic effects to fetuses. Lead is stored in the bones and eliminated from the body very slowly. Consequently, exposures to low levels over many years can cause these adverse health effects. Lead is toxic by inhalation and ingestion, but is not absorbed through the skin. Some common symptoms of chronic overexposure include loss of appetite, metallic taste in mouth, anxiety, insomnia and muscle and joint pain or soreness.

4. Regulations

Inorganic lead has been specifically regulated in general industry by OSHA since 1981 (29 CFR 1910.1025) and in construction (29 CFR 1926.62) since 1994. The 8-hour permissible exposure limit is 50 $\mu g/m^3$. There is no short-term exposure limit. OSHA also specifies an action level of 30$\mu g/m^3$. These limits apply to both general industry and construction. Initial air monitoring must be done whenever there are indications of lead exposure above the action level. If the action level is not exceeded, air monitoring can cease. If the action level is exceeded, initial blood lead level monitoring must be made available. If exposed above the action level for more than 30 days in a year, medical surveillance must be provided which includes further blood lead level monitoring and a medical examination. If specified blood levels are exceeded, the employee must be removed from the job or task where lead exposure occurs. Training must also be provided. If the PEL is exceeded, engineering controls must be implemented to reduce exposure. If engineering controls are not feasible or ineffective, respirators must be provided and worn. Air-purifying respirators with high-efficiency (HEPA) filters can be worn when airborne levels are as high as 500 $\mu g/m^3$. If levels exceed this amount, supplied air respirators must be worn. In addition, if the PEL is

exceeded, OSHA requires the establishment of regulated areas, showers, change rooms, separate clean lunchrooms and warning signs. Regulated areas are demarcated from the rest of the workplace to limit access to authorized personnel who have received lead training. To enter a regulated area you must also wear protective clothing. Tetraethyl and tetramethyl lead each have separate PELs of 100 $\mu g/m^3$ and 150 $\mu g/m^3$ respectively, and are not covered under the inorganic lead regulation.

5. How Exposures Can Occur At CH2M HILL Projects

Exposure to lead can occur at hazardous waste sites where lead is found in soil or groundwater and at old mining sites or former smelter sites. Exposure to lead-containing dust could occur during drilling, heavy equipment movement or other soil-disturbing activities. Dust formation can be minimized by wetting soils. Exposure could also occur during lead paint removal activities, during welding on metal surfaces with lead-containing paint, or in project work in smelters, battery recycling or manufacturing plants or at some mines.

6. Additional Information

Persons working at hazardous waste sites with known high amounts in soils (3 percent or 30,000 ppm) should have blood lead draws taken before and after site work. Air sampling should be done during soil disturbing activities at the site. Person working at non-hazardous waste site who have information or suspect they have been exposed to lead above the action level should contact a health and safety manager to determine if medical monitoring is needed or other regulatory requirements apply.

Lead Quiz

1. Which of the following is not a mode of entry of lead?
   A. Inhalation
   B. Ingestion
   C. Skin absorption
   D. All of the above are modes of entry
2. Which of the following is not a common symptom of lead exposure?
   A. Loss of appetite
   B. Metallic taste in mouth
   C. Muscle and joint pain or soreness
   D. All are common symptoms of lead exposure
3. What are the OSHA exposure limits for lead (PEL and action level)?
   A. 50 $\mu g/m^3$ and 25 $\mu g/m^3$ respectively
   B. 50 ppm and 25 ppm respectively
   C. 50 ppm and 30 ppm respectively
   D. 50 $\mu g/m^3$ and 30 $\mu g/m^3$ respectively
4. When is air monitoring required for lead exposures?
   A. When exposed to lead for 30 days or more in a year
   B. Anytime lead is present in the workplace
   C. When there are indications of lead exposure above the action level
   D. When the PEL is exceeded
5. When must medical surveillance be made available for lead exposures?
   A. When the action level is exceeded
   B. When the action level is exceeded for 30 days in a year
   C. When the PEL is exceeded
   D. When the PEL is exceeded for 30 days in a year
6. When is respiratory protection required for lead exposures?
   A. When the action level is exceeded
   B. When the action level is exceeded for 30 days in a year

C. When engineering controls do not reduce exposure below the PEL

D. When the PEL is exceeded for 30 days in a year

7. What respiratory protection is considered acceptable for protection against lead exposures?

   A. Air-purifying with organic vapor cartridge

   B. Air-purifying with HEPA cartridge

   C. Air-purifying with lead cartridge

   D. Supplied-air respirator is the only acceptable respiratory protection

8. What are the requirements for entering a lead-regulated area?

   A. Must be an authorized person

   B. Must complete lead training

   C. Must wear protective clothing

   D. All of the above

9. What control measure should be used to minimize dust formation when disturbing lead-containing soil?"

   A. Training

   B. Wetting the soil

   C. Air purifying respirators

   D. None of the above

10. What level of lead in the soil might require a lead blood test?

   A. 1% or 10,000 ppm

   B. 3% or 30.000 ppm

   C. 5% or 50,000 ppm

   D. None of the above

APPENDIX E-1 SWMU 6 – MANGROVE DISPOSAL SITE

Site-Specific Investigation-Derived Waste Plan Checklist

This checklist supplements the Master IDW Plan with site-specific information. Once completed for a specific project, it provides necessary IDW information for each investigation. It is to be taken into the field with the Master IDW Plan.

Site: **SWMU 6 – Mangrove Disposal Site**

1. IDW Media:
   - X Soil cuttings
   - X Well development or purge water
   - X Decontamination residual soil and wastewater
   - X PPE or disposable equipment
   - _____ Other _____

2. Expected Regulatory Status:
   - _____ Hazardous
   - _____ Solid Waste
   - X Unknown
   - X Other Waste management activities regulated by OSHA Hazwoper standard (1910.120)

3. Site Location: Decontamination fluids and PPE will be generated at all SWMUs.

4. Nature of Contaminants Expected:
   - X Petroleum contamination
   - X Polyaromatic hydrocarbon
   - X Pesticides
   - X Herbicides
   - X PCBs
   - X Metals
   - X Other Contaminant concentrations from previous analytical results were very low for all of the above.

5. Volume of IDW Expected:
   - X Drums: 5 for soil and drilling cuttings, 2 for decontamination water, 1 for fluids and other disposable items.
   - _____ Cubic Yards
   - _____ Tons
   - _____ Gallons

6. Compositing Strategy for Sample Collection: IDW sampling planned based on disposal decisions on analytical results from sampling.

7. IDW Storage

   X As per Master IDW Plan _____ Other _____

8. Waste Disposal

   X As per Master IDW Plan _____ Other _____

APPENDIX E-1 SWMU 6 – MANGROVE DISPOSAL SITE

Site-Specific Quality Assurance Project Plan Checklist

This checklist supplements the Master QAPP with site-specific information. Once completed for a specific project, it provides necessary quality assurance information for each investigation. It is to be taken into the field with the Master QAPP.

Site: **NASD**

1. List sampling tasks: Groundwater and subsurface soil sampling, surface soil sampling, surface water and sediment sampling, and monitoring well installation.

2. List data quality objectives:

3. Organization:

LANTDIV Navy Technical Representative	Chris Penny/LANTDIV
CH2M HILL Activity Manager	John Tomik/CH2M HILL
Quality Control Senior Review	Kevin Sanders/CH2M HILL
Technical Project Manager	Marty Clasen/CH2M HILL
Field Team Leader	Erik Isern/CH2M HILL

4. Table of samples with analyses to be performed and associated QC samples included in the SWMU and AOC Investigation Workplan:

5. Analytical Quantitation Limits:
   X As per Table 8-2 of Master QAPP _____ Other (attached)

6. QA/QC Acceptance Criteria (e.g., precision, accuracy)
   X As per Table 4-1 of Master QAPP _____ Other (attached)

7. Data reduction, validation, and reporting:
   X As per Section 9 of Master QAPP _____ Other (attached)

8. Internal QC Procedures (field and laboratory):
   X As per Section 10 of Master QAPP _____ Other (attached)

9. Corrective Action:
   X As per Section 14 of Master QAPP _____ Other (attached)

10. Other deviations from Master QAPP: None

APPENDIX E-1 SWMU 6 – MANGROVE DISPOSAL SITE

Site-Specific Field Sampling Plan Checklist

This checklist supplements the Master Field Sampling Plan with site-specific information. Once completed for a specific project, it provides necessary field sampling information for each investigation. It is to be taken into the field with the Master FSP.

Site: **NASD**

1. Tasks to be performed:

X Geophysical surveys
____ Soil gas surveys
X Surface water and sediment sampling
X Surface soil sampling
____ Soil boring installation
____ Subsurface soil sampling
X Monitoring well installation and development
____ Monitoring well abandonment
X Groundwater sampling
X In-situ groundwater sampling
____ Aquifer testing
X Hydrogeologic measurements
____ Biota sampling
____ Trenching
____ Land surveying
X Investigation derived waste sampling
X Decontamination
____ Other_____

2. Field measurements to be taken:

X temperature
X pH
X dissolved oxygen
X turbidity
X specific conductance
X organic vapor monitoring
X geophysical parameters (list):
X electromagnetic induction
____ ground-penetrating radar
X surveying
____ magnetometry
X global positioning system
____ soil gas parameters (list):
____ combustible gases
X water-level measurements
____ pumping rate
____ other_____

3. Sampling program (nomenclature, etc.):

____ As per Section 3.1 of Master FSP
X Other: As presented in the RI/FS Workplan

4. Map of boring and sampling locations (attach to checklist): See Workplan.

5. Table of field samples to be collected: See RI/FS Workplan.

6. Applicable SOPs (attach to checklist) or references to specific pages in Master FSP: The following SOPs from the Master Project Plans are to be implemented:

- Shallow Soil Sampling
- Soil Sampling
- Soil Boring Sampling Split-Spoon

- Surface Water Sampling
- Sediment Sampling
- Groundwater Sampling From Monitoring Wells
- Low-Flow Groundwater Sampling from Monitoring wells
- Monitoring Well Installation
- Homogenization of Soil and Sediment Samples
- VOC Sampling - Water
- Field Filtering
- Chain-of-Custody
- Packaging and Shipping Procedures
- Field Rinse Blank Preparation
- Soil Boring Drilling and Abandonment
- Water Level Measurements
- Logging of Soil Borings
- Decontamination of Personnel and Equipment
- Decontamination of Drilling Rigs and Equipment
- Disposal of Fluids and solids

7. Site-specific procedures or updates to protocols established in the Master FSP:
Described in the RI/FS Workplan.

Site-Specific Health and Safety Plan

This checklist must be used in conjunction with the Master HASP. This checklist is intended for use by CH2M HILL employees only. All CH2M HILL employees performing tasks under this checklist must read and sign both this checklist and the Master HASP and agree to abide by their provisions (see EMPLOYEE SIGNOFF attached to the checklist.

Site: **NASD**

Location(s): SMWU and AOC Location Maps and Individual SWMU and AOC figures are included in the Workplan.

This document shall be maintained on site with the Master Health and Safety Plan. It will include as attachments from the Work Plan a site map and the site characterization and objectives for this site.

The procedures described in the Master Health and Safety Plan will be followed unless otherwise specified in this Site-Specific Health and Safety Plan.

1. HAZWOPER-Regulated Tasks

_____Test pit and excavation
X_____Soil boring installation
_____Geoprobe boring
X_____Geophysical surveys
X_____Hand augering
X_____Subsurface soil sampling
X_____Surface soil sampling
_____Soil gas surveys
X_____Sediment sampling
X_____Monitoring well/drive point installation
_____Monitoring well abandonment
X_____Groundwater sampling
_____Aquifer testing
X_____Hydrologic measurements
X_____Surface water sampling
_____Biota sampling
X_____Investigation-derived waste (drum) sampling and disposal
_____Observation of loading of material for offsite disposal
_____Oversight of remediation and construction
_____Other_____

2. Hazards of Concern: (Check as many as are applicable. Refer to Section 3 of Master H&S Plan for control measures):

X_____Heat stress
X_____Cold stress
_____Buried utilities, drums, tanks
_____Inadequate illumination
X_____Drilling
_____Heavy equipment
X_____Working near water
_____Flying debris
_____Gas cylinders
X_____Noise
X_____Slip, trip, or fall hazards
X_____Back injury
_____Confined space entry
_____Trenches, excavations
_____Protruding objects
_____Vehicle traffic
_____Ladders, scaffolds
_____Fire
X_____Working on water
X_____Bees or insects
_____Poison ivy, oak, sumac
X_____Ticks
_____Radiological
_____Other_____

3. Contaminants of Concern (List if known. Reduce Table 3.8 of the Master HASP to site-specific contaminants, add additional chemicals if necessary, and attach to this checklist):

PCBs	Metals	VOCs
PNAs	SVOCs	Pesticides

4. Personnel (List CH2M HILL field team members and telephone numbers):

Field team leader(s)	Erik Isern	
Site safety coordinator(s)	Erik Isern	
Field team members	TBD	

5. Contractors/Subcontractors

X Procedures as per Master HASP

X Other

Name: To be added		
Contact: To be added		
Telephone: To be added		

6. Level of personal protective equipment (PPE) required: D
Refer to Table 5.1 of Master HASP, CH2M HILL SOPs HS-07 and HS-08, and Respiratory Protection, Section 2 of the Site Safety Notebook.

7. Air monitoring instruments to be used:

X OVM 10.6	FID
CGI	Dust monitor
O_2	

8. Decontamination procedures:

As per Section 7 of Master HASP

X Other: As described in the RI/FS Workplan.

9. List any other deviations or variations from the Master HASP: None

10. Emergency Response (Check that all names and numbers are correct on page 47 of Master HASP and attach corrected page to this checklist)

11. Map to hospital (Highlight route to hospital from site and attach to this checklist)

12. Emergency Contacts (Check that all names and numbers are correct on page 49 of Master HASP and attach corrected page to this checklist)

13. Approval. This prepared site-specific checklist must be approved by Mike Goldman/ATL or their authorized representative

Name_____ **Title**: Health and Safety Manager **Date**_____

(Signature will be included in the F inal HASP)

14. Employee Signoff. All CH2M HILL employees working at the site must sign the attached Employee Signoff for the checklist as well as for the Master HASP.

_____Site

HASP Checklist Employee Signoff

The employees listed below have been given a copy of this health and safety plan checklist, have read and understood it, and agree to abide by its provisions.

EMPLOYEE NAME	EMPLOYEE SIGNATURE AND DATE

Site-Specific Work Plan Checklist

This checklist supplements the Master Work Plan (WP) with site-specific information. Once completed for a specific project, it provides necessary quality assurance information for each investigation. It is to be taken into the field with the Master WP.

Site(s): **NASD**

1. Discussion of site background, previous investigations, and previous analytical results:

2. Description of site-specific geology, topography, water table elevation, and local direction of groundwater flow:

3. Map illustrating the area of investigation in relation to the entire Base:

4. Discussion of the field investigation and activities to be performed at the site, including methods, locations, and types of drilling, sampling, and analyses to be performed:

5. Map illustrating boring, well, and sample locations:

6. Description of the feasibility study tasks to be performed at the site:

7. Explanation of staff organization and task order management:

8. Task order schedule:

APPENDIX E-2 SWMU 7 - QUEBRADA DISPOSAL SITE

Site-Specific Investigation-Derived Waste Plan Checklist

This checklist supplements the Master IDW Plan with site-specific information. Once completed for a specific project, it provides necessary IDW information for each investigation. It is to be taken into the field with the Master IDW Plan.

Site: **NASD**

1. IDW Media:
   - X Soil cuttings
   - X Well development or purge water
   - X Decontamination residual soil and wastewater
   - X PPE or disposable equipment
   - ____ Other _____

2. Expected Regulatory Status:
   - ____ Hazardous
   - ____ Solid Waste
   - X Unknown
   - X Other: Waste management activities regulated by OSHA Hazwoper standard (1910.120)

3. Site Location: Decontamination fluids and PPE will be generated at all SWMUs.

4. Nature of Contaminants Expected:
   - X Petroleum contamination
   - X Polyaromatic hydrocarbon
   - X Pesticides
   - X Herbicides
   - X PCBs
   - X Metals
   - X Other - Contaminant concentrations from previous analytical results were very low for all of the above.

5. Volume of IDW Expected:
   - X Drums (12 for drilling cuttings, 2 for soil samples, 1 for decontamination fluids, 4 for purge water, 1 for PPE and other disposible items)
   - ____ Cubic Yards
   - ____ Tons
   - ____ Gallons

6. Compositing Strategy for Sample Collection: IDW sampling planned based on disposal decisions on analytical results from sampling.

7. IDW Storage
   - X As per Master IDW Plan
   - ____ Other_____

8. Waste Disposal
   - X As per Master IDW Plan
   - ____ Other_____

Site-Specific Quality Assurance Project Plan Checklist

This checklist supplements the Master QAPP with site-specific information. Once completed for a specific project, it provides necessary quality assurance information for each investigation. It is to be taken into the field with the Master QAPP.

Site: **NASD**

1. List sampling tasks: Groundwater and subsurface soil sampling, surface soil sampling, and monitoring well installations.

2. List data quality objectives: The objective of the SWMU and AOC Investigation is to determine the need for further action at SWMU 7. Previous analytical data and the analytical data generated from the Investigation will be reviewed and a recommendation for no further action or additional investigation will be made based on the data.

3. Organization:

LANTDIV Navy Technical Representative	Chris Penny/LANTDIV
VDEQ Federal Facilities Project Manager	Eugene Scott/PREQB
CH2M HILL Activity Manager	John Tomik/CH2M HILL
Quality Control Senior Review	Kevin Sanders/CH2M HILL
Technical Project Manager	Marty Clasen/CH2M HILL
Field Team Leader	Erik Isern/CH2M HILL

4. Table of samples with analyses to be performed and associated QC samples included in the SWMU and AOC Investigation Workplan:

5. Analytical Quantitation Limits:

   X As per Table 8-2 of Master QAPP _____ Other (attached)

6. QA/QC Acceptance Criteria (e.g., precision, accuracy)

   X As per Table 4-1 of Master QAPP _____ Other (attached)

7. Data reduction, validation, and reporting:

   X As per Section 9 of Master QAPP _____ Other (attached)

8. Internal QC Procedures (field and laboratory):

   X As per Section 10 of Master QAPP _____ Other (attached)

9. Corrective Action:

   X As per Section 14 of Master QAPP _____ Other (attached)

10. Other deviations from Master QAPP: None

Site-Specific Field Sampling Plan Checklist

This checklist supplements the Master Field Sampling Plan with site-specific information. Once completed for a specific project, it provides necessary field sampling information for each investigation. It is to be taken into the field with the Master FSP.

Site: NASD

1. Tasks to be performed:

_____Geophysical surveys
_____Soil gas surveys
_____Surface water and sediment sampling
X_____Surface soil sampling
X_____Soil boring installation
X_____Subsurface soil sampling
X_____Monitoring well installation and development
_____Monitoring well abandonment
X_____Groundwater sampling
X_____In-situ groundwater sampling
_____Aquifer testing
X_____Hydrogeologic measurements
_____Biota sampling
_____Trenching
_____Land surveying
X_____Investigation derived waste sampling
X_____Decontamination
_____Other_____

2. Field measurements to be taken:

X_____temperature
X_____pH
X_____dissolved oxygen
X_____turbidity
X_____specific conductance
X_____organic vapor monitoring
X_____geophysical parameters (list):
_____electromagnetic induction
_____ground-penetrating radar
X_____surveying
_____magnetometry
X_____global positioning system
_____soil gas parameters (list):
_____combustible gases
X_____water-level measurements
_____pumping rate
_____other_____

3. Sampling program (nomenclature, etc.):

_____As per Section 3.1 of Master FSP
X_____Other: As presented in the RI/FS Workplan

4. Map of boring and sampling locations (attach to checklist): See Workplan.

5. Table of field samples to be collected: See RI/FS Workplan.

6. Applicable SOPs (attach to checklist) or references to specific pages in Master FSP: The following SOPs from the Master Project Plans are to be implemented.

- Shallow Soil Sampling
- Soil Sampling
- Soil Boring Sampling Split-Spoon
- Surface Water Sampling
- Sediment Sampling
- Groundwater Sampling From Monitoring Wells
- Low-Flow Groundwater Sampling from Monitoring wells
- Monitoring Well Installation
- Homogenization of Soil and Sediment Samples
- VOC Sampling - Water
- Field Filtering
- Chain-of-Custody
- Packaging and Shipping Procedures
- Field Rinse Blank Preparation
- Soil Boring Drilling and Abandonment
- Water Level Measurements
- Logging of Soil Borings
- Decontamination of Personnel and Equipment
- Decontamination of Drilling Rigs and Equipment
- Disposal of Fluids and solids

7. Site-specific procedures or updates to protocols established in the Master FSP: Described in the RI/FS Workplan.

Site-Specific Health and Safety Plan

This checklist must be used in conjunction with the Master HASP. This checklist is intended for use by CH2M HILL employees only. All CH2M HILL employees performing tasks under this checklist must read and sign both this checklist and the Master HASP and agree to abide by their provisions (see EMPLOYEE SIGNOFF attached to the checklist.

Site: **NASD**

Location(s): SWMU and AOC Location Maps and Individual SWMU and AOC figures are included in the Workplan.

This document shall be maintained on site with the Master Health and Safety Plan. It will include as attachments from the Work Plan a site map and the site characterization and objectives for this site.

The procedures described in the Master Health and Safety Plan will be followed unless otherwise specified in this Site-Specific Health and Safety Plan.

1. HAZWOPER-Regulated Tasks

_____Test pit and excavation
X_____Soil boring installation
_____Geoprobe boring
_____Geophysical surveys
X_____Hand augering
X_____Subsurface soil sampling
X_____Surface soil sampling
_____Soil gas surveys
_____Sediment sampling
X_____Monitoring well/drive point installation
_____Monitoring well abandonment
X_____Groundwater sampling
_____Aquifer testing
X_____Hydrologic measurements
_____Surface water sampling
_____Biota sampling
X_____Investigation-derived waste (drum) sampling and disposal
_____Observation of loading of material for offsite disposal
_____Oversight of remediation and construction
_____Other_____

2. Hazards of Concern: (Check as many as are applicable. Refer to Section 3 of Master H&S Plan for control measures):

X_____Heat stress
X_____Cold stress
_____Buried utilities, drums, tanks
_____Inadequate illumination
X_____Drilling
_____Heavy equipment
_____Working near water
_____Flying debris
_____Gas cylinders
X_____Noise
X_____Slip, trip, or fall hazards
X_____Back injury
_____Confined space entry
_____Trenches, excavations
_____Protruding objects
_____Vehicle traffic

_____Ladders, scaffolds	X_____Poison ivy, oak, sumac
_____Fire	X_____Ticks
_____Working on water	_____Radiological
X_____Bees or insects	_____Other_____

3. Contaminants of Concern (List if known. Reduce Table 3.8 of the Master HASP to site-specific contaminants, add additional chemicals if necessary, and attach to this checklist):

Pesticides	Metals	VOCs
PNAs	SVOCs	

4. Personnel (List CH2M HILL field team members and telephone numbers):

Field team leader(s)	Erik Isern	
Site safety coordinator(s)	Erik Isern	
Field team members	TBD	

5. Contractors/Subcontractors

X_____Procedures as per Master HASP

X_____Other_____

Name: To be added		
Contact: To be added		
Telephone: To be added		

6. Level of personal protective equipment (PPE) required: D

Refer to Table 5.1 of Master HASP, CH2M HILL SOPs HS-07 and HS-08, and Respiratory Protection, Section 2 of the Site Safety Notebook.

7. Air monitoring instruments to be used:

X_____OVM 10.6	_____FID
_____CGI	_____Dust monitor
_____O_2	

8. Decontamination procedures:

_____As per Section 7 of Master HASP

X_____Other: As described in the RI/FS Workplan.

9. List any other deviations or variations from the Master HASP: None.

10. Emergency Response (Check that all names and numbers are correct on page 47 of Master HASP and attach corrected page to this checklist)

11. Map to hospital (Highlight route to hospital from site and attach to this checklist)

12. Emergency Contacts (Check that all names and numbers are correct on page 49 of Master HASP and attach corrected page to this checklist)

13. Approval. This prepared site-specific checklist must be approved by Mike Goldman/ATL or their authorized representative

    Name:_____ **Title:** Health and Safety Manager **Date:**_____

    (Signature will be included in the Final HASP)

14. Employee Signoff. All CH2M HILL employees working at the site must sign the attached Employee Signoff for the checklist as well as for the Master HASP.

_____Site

HASP Checklist Employee Signoff

The employees listed below have been given a copy of this health and safety plan checklist, have read and understood it, and agree to abide by its provisions.

EMPLOYEE NAME	EMPLOYEE SIGNATURE AND DATE

Site-Specific Work Plan Checklist

This checklist supplements the Master Work Plan (WP) with site-specific information. Once completed for a specific project, it provides necessary quality assurance information for each investigation. It is to be taken into the field with the Master WP.

Site(s): _____

1. Discussion of site background, previous investigations, and previous analytical results:

2. Description of site-specific geology, topography, water table elevation, and local direction of groundwater flow:

3. Map illustrating the area of investigation in relation to the entire Base:

4. Discussion of the field investigation and activities to be performed at the site, including methods, locations, and types of drilling, sampling, and analyses to be performed:

5. Map illustrating boring, well, and sample locations:

6. Description of the feasibility study tasks to be performed at the site:

7. Explanation of staff organization and task order management:

8. Task order schedule:

Site-Specific Investigation-Derived Waste Plan Checklist

This checklist supplements the Master IDW Plan with site-specific information. Once completed for a specific project, it provides necessary IDW information for each investigation. It is to be taken into the field with the Master IDW Plan.

Site: **NASD**

1. IDW Media:
   - X Soil cuttings
   - X Well development or purge water
   - X Decontamination residual soil and wastewater
   - X PPE or disposable equipment
   - ____ Other _____

2. Expected Regulatory Status:
   - ____ Hazardous
   - ____ Solid Waste
   - X Unknown
   - X Other: Waste management activities regulated by OSHA Hazwoper standard (1910.120)

3. Site Location: Decontamination fluids and PPE will be generated at all SWMUs.

4. Nature of Contaminants Expected:
   - X Petroleum contamination
   - X Polyaromatic hydrocarbon
   - X Pesticides
   - X Herbicides
   - X PCBs
   - X Metals
   - X Other: Contaminant concentrations from previous analytical results were very low for all of the above.

5. Volume of IDW Expected:
   - X Drums (4 for soil cuttings, 2 for soil samples, 2 for decontamination fluids, 3 for purge water, 1 for PPE and other disposable items)
   - ____ Cubic Yards
   - ____ Tons
   - ____ Gallons

6. Compositing Strategy for Sample Collection: IDW sampling planned based all disposal decisions on analytical results from sampling.

7. IDW Storage

   X As per Master IDW Plan ____ Other _____

8. Waste Disposal

   X As per Master IDW Plan ____ Other _____

Site-Specific Quality Assurance Project Plan Checklist

This checklist supplements the Master QAPP with site-specific information. Once completed for a specific project, it provides necessary quality assurance information for each investigation. It is to be taken into the field with the Master QAPP.

Site: **NASD**

1. List sampling tasks: Groundwater, subsurface soil sampling, surface soil boring, surface water sampling, and sediment sampling.

2. List data quality objectives: The objective of the SWMU and AOC Investigation is to determine the need for further action at each AOC. Previous analytical data and the analytical data generated from the Investigation will be reviewed and a recommendation for no further action or additional investigation will be made based on the data.

3. Organization:

LANTDIV Navy Technical Representative	Chris Penny/LANTDIV
VDEQ Federal Facilities Project Manager	Eugene Scott/PREQB
CH2M HILL Activity Manager	John Tomik/CH2M HILL
Quality Control Senior Review	Kevin Sanders/CH2M HILL
Technical Project Manager	Marty Clasen/CH2M HILL
Field Team Leader	Erik Isern/CH2M HILL

4. Table of samples with analyses to be performed and associated QC samples included in the SWMU and AOC Investigation Workplan:

5. Analytical Quantitation Limits:

   X As per Table 8-2 of Master QAPP _____ Other (attached)

6. QA/QC Acceptance Criteria (e.g., precision, accuracy)

   X As per Table 4-1 of Master QAPP _____ Other (attached)

7. Data reduction, validation, and reporting:

   X As per Section 9 of Master QAPP _____ Other (attached)

8. Internal QC Procedures (field and laboratory):

   X As per Section 10 of Master QAPP _____ Other (attached)

9. Corrective Action:

   X As per Section 14 of Master QAPP _____ Other (attached)

10. Other deviations from Master QAPP: None

Site-Specific Field Sampling Plan Checklist

This checklist supplements the Master Field Sampling Plan with site-specific information. Once completed for a specific project, it provides necessary field sampling information for each investigation. It is to be taken into the field with the Master FSP.

Site: **NASD**

1. Tasks to be performed:

_____Geophysical surveys	X_____Groundwater sampling
_____Soil gas surveys	X_____In-situ groundwater sampling
X_____Surface water and sediment sampling	_____Aquifer testing
	X_____Hydrogeologic measurements
X_____Surface soil sampling	_____Biota sampling
X_____Soil boring installation	_____Trenching
X_____Subsurface soil sampling	_____Land surveying
X_____Monitoring well installation and development	X_____Investigation derived waste sampling
	X_____Decontamination
_____Monitoring well abandonment	_____Other_____

2. Field measurements to be taken:

X_____temperature	X_____surveying
X_____pH	_____magnetometry
X_____dissolved oxygen	X_____global positioning system
X_____turbidity	_____soil gas parameters (list):
X_____specific conductance	_____combustible gases
X_____organic vapor monitoring	X_____water-level measurements
X_____geophysical parameters (list):	_____pumping rate
_____electromagnetic induction	_____other_____
_____ground-penetrating radar	

3. Sampling program (nomenclature, etc.):

_____As per Section 3.1 of Master FSP X_____Other: As presented in the RI/FS Workplan.

4. Map of boring and sampling locations (attach to checklist): See Workplan.

5. Table of field samples to be collected: See RI/FS Workplan.

6. Applicable SOPs (attach to checklist) or references to specific pages in Master FSP: The following SOPs from the Master Project Plans are to be implemented.

- Shallow Soil Sampling
- Soil Sampling
- Soil Boring Sampling Split-Spoon
- Surface Water Sampling
- Sediment Sampling
- Groundwater Sampling From Monitoring Wells
- Low-Flow Groundwater Sampling from Monitoring wells
- Monitoring Well Installation
- Homogenization of Soil and Sediment Samples
- VOC Sampling - Water
- Field Filtering
- Chain-of-Custody
- Packaging and Shipping Procedures
- Field Rinse Blank Preparation
- Soil Boring Drilling and Abandonment
- Water Level Measurements
- Logging of Soil Borings
- Decontamination of Personnel and Equipment
- Decontamination of Drilling Rigs and Equipment
- Disposal of Fluids and solids

7. Site-specific procedures or updates to protocols established in the Master FSP: Decribed in the RI/FS Workplan.

Site-Specific Health and Safety Plan

This checklist must be used in conjunction with the Master HASP. This checklist is intended for use by CH2M HILL employees only. All CH2M HILL employees performing tasks under this checklist must read and sign both this checklist and the Master HASP and agree to abide by their provisions (see EMPLOYEE SIGNOFF attached to the checklist.

Site: **NASD**

Location(s): SWMU and AOC Location Maps and Individual SWMU and AOC figures are included in the Workplan.

This document shall be maintained on site with the Master Health and Safety Plan. It will include as attachments from the Work Plan a site map and the site characterization and objectives for this site.

The procedures described in the Master Health and Safety Plan will be followed unless otherwise specified in this Site-Specific Health and Safety Plan.

1. HAZWOPER-Regulated Tasks

_____Test pit and excavation
X_____Soil boring installation
_____Geoprobe boring
_____Geophysical surveys
X_____Hand augering
X_____Subsurface soil sampling
X_____Surface soil sampling
_____Soil gas surveys
X_____Sediment sampling
X_____Monitoring well/drive point installation
_____Monitoring well abandonment
X_____Groundwater sampling
_____Aquifer testing
X_____Hydrologic measurements
X_____Surface water sampling
_____Biota sampling
X_____Investigation-derived waste (drum) sampling and disposal
_____Observation of loading of material for offsite disposal
_____Oversight of remediation and construction
_____Other_____

2. Hazards of Concern: (Check as many as are applicable. Refer to Section 3 of Master H&S Plan for control measures):

X_____Heat stress
X_____Cold stress
_____Buried utilities, drums, tanks
_____Inadequate illumination
X_____Drilling
_____Heavy equipment
X_____Working near water
_____Flying debris
_____Gas cylinders
X_____Noise
X_____Slip, trip, or fall hazards
X_____Back injury
_____Confined space entry
_____Trenches, excavations
_____Protruding objects
_____Vehicle traffic
_____Ladders, scaffolds
_____Fire
X_____Working on water
X_____Bees or insects
X_____Poison ivy, oak, sumac
X_____Ticks
_____Radiological
_____Other_____

APPENDIX E-3 AOC H - POWER PLANT

3. Contaminants of Concern (List if known. Reduce Table 3.8 of the Master HASP to site-specific contaminants, add additional chemicals if necessary, and attach to this checklist):

Metals	VOCs	PNAs
SVOCs	Pesticides	

4. Personnel (List CH2M HILL field team members and telephone numbers):

Field team leader(s)	Erik Isern	
Site safety coordinator(s)	Erik Isern	
Field team members	TBD	

5. Contractors/Subcontractors

X Procedures as per Master HASP

X Other _____

Name:			
Contact:			
Telephone:			

6. Level of personal protective equipment (PPE) required: D
Refer to Table 5.1 of Master HASP, CH2M HILL SOPs HS-07 and HS-08, and Respiratory Protection, Section 2 of the Site Safety Notebook.

7. Air monitoring instruments to be used:

X OVM 10.6	FID
CGI	Dust monitor
O_2	

8. Decontamination procedures:

As per Section 7 of Master HASP

X Other: As described in the RI/FS Workplan.

9. List any other deviations or variations from the Master HASP: None

10. Emergency Response (Check that all names and numbers are correct on page 47 of Master HASP and attach corrected page to this checklist)

11. Map to hospital (Highlight route to hospital from site and attach to this checklist)

12. Emergency Contacts (Check that all names and numbers are correct on page 49 of Master HASP and attach corrected page to this checklist)

13. Approval. This prepared site-specific checklist must be approved by Mike Goldman/ATL or their authorized representative

Name_____**Title:** Health and Safety Manager **Date**_____

(Signature will be included in the Final HASP)

14. Employee Signoff. All CH2M HILL employees working at the site must sign the attached Employee Signoff for the checklist as well as for the Master HASP.

_____Site

HASP Checklist Employee Signoff

The employees listed below have been given a copy of this health and safety plan checklist, have read and understood it, and agree to abide by its provisions.

EMPLOYEE NAME	EMPLOYEE SIGNATURE AND DATE

Site-Specific Work Plan Checklist

This checklist supplements the Master Work Plan (WP) with site-specific information. Once completed for a specific project, it provides necessary quality assurance information for each investigation. It is to be taken into the field with the Master WP.

Site(s): NASD

1. Discussion of site background, previous investigations, and previous analytical results:

2. Description of site-specific geology, topography, water table elevation, and local direction of groundwater flow:

3. Map illustrating the area of investigation in relation to the entire Base:

4. Discussion of the field investigation and activities to be performed at the site, including methods, locations, and types of drilling, sampling, and analyses to be performed:

5. Map illustrating boring, well, and sample locations:

6. Description of the feasibility study tasks to be performed at the site:

7. Explanation of staff organization and task order management:

8. Task order schedule:

APPENDIX E-3 AOC H - POWER PLANT

Site-Specific Investigation-Derived Waste Plan Checklist

This checklist supplements the Master IDW Plan with site-specific information. Once completed for a specific project, it provides necessary IDW information for each investigation. It is to be taken into the field with the Master IDW Plan.

Site: **NASD**

1. IDW Media:
   - X Soil cuttings
   - X Well development or purge water
   - X Decontamination residual soil and wastewater
   - X PPE or disposable equipment
   - _____ Other _____

2. Expected Regulatory Status:
   - _____ Hazardous
   - _____ Solid Waste
   - X Unknown
   - X Other: Waste management activities regulated by OSHA Hazwoper standard (1910.120)

3. Site Location: Decontamination fluids and PPE will be generated at all SWMUs.

4. Nature of Contaminants Expected:
   - X Petroleum contamination
   - X Polyaromatic hydrocarbon
   - X Pesticides
   - X Herbicides
   - X PCBs
   - X Metals
   - X Other: Contaminant concentrations from previous analytical results were very low for all of the above.

5. Volume of IDW Expected:
   - X Drums (4 for soil cuttings, 2 for soil samples, 2 for decontamination fluids, 3 for purge water, 1 for PPE and other disposable items)
   - _____ Cubic Yards
   - _____ Tons
   - _____ Gallons

6. Compositing Strategy for Sample Collection: IDW sampling planned based all disposal decisions on analytical results from sampling.

7. IDW Storage

   X As per Master IDW Plan _____ Other _____

8. Waste Disposal

   X As per Master IDW Plan _____ Other _____

Site-Specific Quality Assurance Project Plan Checklist

This checklist supplements the Master QAPP with site-specific information. Once completed for a specific project, it provides necessary quality assurance information for each investigation. It is to be taken into the field with the Master QAPP.

Site: **NASD**

1. List sampling tasks: Groundwater, subsurface soil sampling, surface soil boring, surface water sampling, and sediment sampling.

2. List data quality objectives: The objective of the SWMU and AOC Investigation is to determine the need for further action at each AOC. Previous analytical data and the analytical data generated from the Investigation will be reviewed and a recommendation for no further action or additional investigation will be made based on the data.

3. Organization:

LANTDIV Navy Technical Representative	Chris Penny/LANTDIV
VDEQ Federal Facilities Project Manager	Eugene Scott/PREQB
CH2M HILL Activity Manager	John Tomik/CH2M HILL
Quality Control Senior Review	Kevin Sanders/CH2M HILL
Technical Project Manager	Marty Clasen/CH2M HILL
Field Team Leader	Erik Isern/CH2M HILL

4. Table of samples with analyses to be performed and associated QC samples included in the SWMU and AOC Investigation Workplan:

5. Analytical Quantitation Limits:

X As per Table 8-2 of Master QAPP _____ Other (attached)

6. QA/QC Acceptance Criteria (e.g., precision, accuracy)

X As per Table 4-1 of Master QAPP _____ Other (attached)

7. Data reduction, validation, and reporting:

X As per Section 9 of Master QAPP _____ Other (attached)

8. Internal QC Procedures (field and laboratory):

X As per Section 10 of Master QAPP _____ Other (attached)

9. Corrective Action:

X As per Section 14 of Master QAPP _____ Other (attached)

10. Other deviations from Master QAPP: None

Site-Specific Field Sampling Plan Checklist

This checklist supplements the Master Field Sampling Plan with site-specific information. Once completed for a specific project, it provides necessary field sampling information for each investigation. It is to be taken into the field with the Master FSP.

Site: **NASD**

1. Tasks to be performed:

_____Geophysical surveys	X_____Groundwater sampling
_____Soil gas surveys	X_____In-situ groundwater sampling
X_____Surface water and sediment sampling	_____Aquifer testing
	X_____Hydrogeologic measurements
X_____Surface soil sampling	_____Biota sampling
X_____Soil boring installation	_____Trenching
X_____Subsurface soil sampling	_____Land surveying
X_____Monitoring well installation and development	X_____Investigation derived waste sampling
	X_____Decontamination
_____Monitoring well abandonment	_____Other_____

2. Field measurements to be taken:

X_____temperature	X_____surveying
X_____pH	_____magnetometry
X_____dissolved oxygen	X_____global positioning system
X_____turbidity	_____soil gas parameters (list):
X_____specific conductance	_____combustible gases
X_____organic vapor monitoring	X_____water-level measurements
X_____geophysical parameters (list):	_____pumping rate
_____electromagnetic induction	_____other_____
_____ground-penetrating radar	

3. Sampling program (nomenclature, etc.):

_____As per Section 3.1 of Master FSP X_____Other: As presented in the RI/FS Workplan.

4. Map of boring and sampling locations (attach to checklist): See Workplan.

5. Table of field samples to be collected: See RI/FS Workplan.

6. Applicable SOPs (attach to checklist) or references to specific pages in Master FSP: The following SOPs from the Master Project Plans are to be implemented.

- Shallow Soil Sampling
- Soil Sampling
- Soil Boring Sampling Split-Spoon
- Surface Water Sampling
- Sediment Sampling
- Groundwater Sampling From Monitoring Wells
- Low-Flow Groundwater Sampling from Monitoring wells
- Monitoring Well Installation
- Homogenization of Soil and Sediment Samples
- VOC Sampling - Water
- Field Filtering
- Chain-of-Custody
- Packaging and Shipping Procedures
- Field Rinse Blank Preparation
- Soil Boring Drilling and Abandonment
- Water Level Measurements
- Logging of Soil Borings
- Decontamination of Personnel and Equipment
- Decontamination of Drilling Rigs and Equipment
- Disposal of Fluids and solids

7. Site-specific procedures or updates to protocols established in the Master FSP: Decribed in the RI/FS Workplan.

Site-Specific Health and Safety Plan

This checklist must be used in conjunction with the Master HASP. This checklist is intended for use by CH2M HILL employees only. All CH2M HILL employees performing tasks under this checklist must read and sign both this checklist and the Master HASP and agree to abide by their provisions (see EMPLOYEE SIGNOFF attached to the checklist.

Site: **NASD**

Location(s): SWMU and AOC Location Maps and Individual SWMU and AOC figures are included in the Workplan.

This document shall be maintained on site with the Master Health and Safety Plan. It will include as attachments from the Work Plan a site map and the site characterization and objectives for this site.

The procedures described in the Master Health and Safety Plan will be followed unless otherwise specified in this Site-Specific Health and Safety Plan.

1. HAZWOPER-Regulated Tasks

_____Test pit and excavation
X_____Soil boring installation
_____Geoprobe boring
_____Geophysical surveys
X_____Hand augering
X_____Subsurface soil sampling
X_____Surface soil sampling
_____Soil gas surveys
X_____Sediment sampling
X_____Monitoring well/drive point installation
_____Monitoring well abandonment
X_____Groundwater sampling
_____Aquifer testing
X_____Hydrologic measurements
X_____Surface water sampling
_____Biota sampling
X_____Investigation-derived waste (drum) sampling and disposal
_____Observation of loading of material for offsite disposal
_____Oversight of remediation and construction
_____Other_____

2. Hazards of Concern: (Check as many as are applicable. Refer to Section 3 of Master H&S Plan for control measures):

X_____Heat stress
X_____Cold stress
_____Buried utilities, drums, tanks
_____Inadequate illumination
X_____Drilling
_____Heavy equipment
X_____Working near water
_____Flying debris
_____Gas cylinders
X_____Noise
X_____Slip, trip, or fall hazards
X_____Back injury
_____Confined space entry
_____Trenches, excavations
_____Protruding objects
_____Vehicle traffic
_____Ladders, scaffolds
_____Fire
X_____Working on water
X_____Bees or insects
X_____Poison ivy, oak, sumac
X_____Ticks
_____Radiological
_____Other_____

APPENDIX E-3 AOC H - POWER PLANT

3. Contaminants of Concern (List if known. Reduce Table 3.8 of the Master HASP to site-specific contaminants, add additional chemicals if necessary, and attach to this checklist):

Metals	VOCs	PNAs
SVOCs	Pesticides	

4. Personnel (List CH2M HILL field team members and telephone numbers):

Field team leader(s)	Erik Isern	
Site safety coordinator(s)	Erik Isern	
Field team members	TBD	

5. Contractors/Subcontractors

X Procedures as per Master HASP

X Other

Name:		
Contact:		
Telephone:		

6. Level of personal protective equipment (PPE) required: D
Refer to Table 5.1 of Master HASP, CH2M HILL SOPs HS-07 and HS-08, and Respiratory Protection, Section 2 of the Site Safety Notebook.

7. Air monitoring instruments to be used:

X OVM 10.6	FID
CGI	Dust monitor
O_2	

8. Decontamination procedures:

As per Section 7 of Master HASP

X Other: As described in the RI/FS Workplan.

9. List any other deviations or variations from the Master HASP: None

10. Emergency Response (Check that all names and numbers are correct on page 47 of Master HASP and attach corrected page to this checklist)

11. Map to hospital (Highlight route to hospital from site and attach to this checklist)

12. Emergency Contacts (Check that all names and numbers are correct on page 49 of Master HASP and attach corrected page to this checklist)

13. Approval. This prepared site-specific checklist must be approved by Mike Goldman/ATL or their authorized representative

Name_____**Title:** Health and Safety Manager **Date**_____

(Signature will be included in the Final HASP)

14. Employee Signoff. All CH2M HILL employees working at the site must sign the attached Employee Signoff for the checklist as well as for the Master HASP.

_____Site

HASP Checklist Employee Signoff

The employees listed below have been given a copy of this health and safety plan checklist, have read and understood it, and agree to abide by its provisions.

EMPLOYEE NAME	EMPLOYEE SIGNATURE AND DATE

Site-Specific Work Plan Checklist

This checklist supplements the Master Work Plan (WP) with site-specific information. Once completed for a specific project, it provides necessary quality assurance information for each investigation. It is to be taken into the field with the Master WP.

Site(s): NASD

1. Discussion of site background, previous investigations, and previous analytical results:

2. Description of site-specific geology, topography, water table elevation, and local direction of groundwater flow:

3. Map illustrating the area of investigation in relation to the entire Base:

4. Discussion of the field investigation and activities to be performed at the site, including methods, locations, and types of drilling, sampling, and analyses to be performed:

5. Map illustrating boring, well, and sample locations:

6. Description of the feasibility study tasks to be performed at the site:

7. Explanation of staff organization and task order management:

8. Task order schedule:

APPENDIX E-4 AOC J - FORMER STAGING AREA DISPOSAL SITE

Site-Specific Investigation-Derived Waste Plan Checklist

This checklist supplements the Master IDW Plan with site-specific information. Once completed for a specific project, it provides necessary IDW information for each investigation. It is to be taken into the field with the Master IDW Plan.

Site: **NASD**

1. IDW Media:
   - X Soil cuttings
   - X Well development or purge water
   - X Decontamination residual soil and wastewater
   - X PPE or disposable equipment
   - _____ Other _____

2. Expected Regulatory Status:
   - _____ Hazardous
   - _____ Solid Waste
   - X Unknown
   - X Other: Waste management activities regulated by OSHA Hazwoper standard (1910.120)

3. Site Location: Decontamination fluids and PPE will be generated at all SWMUs.

4. Nature of Contaminants Expected:
   - X Petroleum contamination
   - X Polyaromatic hydrocarbon
   - X Pesticides
   - X Herbicides
   - X PCBs
   - X Metals
   - X Other: Contaminant concentrations from previous analytical results were very low for all of the above.

5. Volume of IDW Expected:
   - X Drums (7 for Soil Cuttings, 1 for Soil Samples, 1 for decontamination fluids, 3 for purge water, 1 for PPE and other disposable items).
   - _____ Cubic Yards
   - _____ Tons
   - _____ Gallons

6. Compositing Strategy for Sample Collection: IDW sampling planned based on disposal decisions on analytical results from sampling.

7. IDW Storage
   - X As per Master IDW Plan
   - _____ Other _____

8. Waste Disposal
   - X As per Master IDW Plan
   - _____ Other _____

Site-Specific Quality Assurance Project Plan Checklist

This checklist supplements the Master QAPP with site-specific information. Once completed for a specific project, it provides necessary quality assurance information for each investigation. It is to be taken into the field with the Master QAPP.

Site: **NASD**

1. List sampling tasks: Groundwater, surface water and sediment sampling, and monitoring well installaiton.

2. List data quality objectives: The objective of the SWMU and AOC Investigation is to determine the need for further action at each AOC. Previous analytical data and the analytical data generated from the Investigation will be reviewed and a recommendation for no further action or additional investigation will be made based on the data.

3. Organization:

LANTDIV Navy Technical Representative	Chris Penny/LANTDIV
VDEQ Federal Facilities Project Manager	Eugene Scott/PREQB
CH2M HILL Activity Manager	John Tomik/CH2M HILL
Quality Control Senior Review	Kevin Sanders/CH2M HILL
Technical Project Manager	Marty Clasen/CH2M HILL
Field Team Leader	Erik Isern/CH2M HILL

4. Table of samples with analyses to be performed and associated QC samples included in the SWMU and AOC Investigation Workplan:

5. Analytical Quantitation Limits:

   X As per Table 8-2 of Master QAPP _____ Other (attached)

6. QA/QC Acceptance Criteria (e.g., precision, accuracy)

   X As per Table 4-1 of Master QAPP _____ Other (attached)

7. Data reduction, validation, and reporting:

   X As per Section 9 of Master QAPP _____ Other (attached)

8. Internal QC Procedures (field and laboratory):

   X As per Section 10 of Master QAPP _____ Other (attached)

9. Corrective Action:

   X As per Section 14 of Master QAPP _____ Other (attached)

10. Other deviations from Master QAPP: None

Site-Specific Field Sampling Plan Checklist

This checklist supplements the Master Field Sampling Plan with site-specific information. Once completed for a specific project, it provides necessary field sampling information for each investigation. It is to be taken into the field with the Master FSP.

Site: **NASD**

1. Tasks to be performed:

X Geophysical surveys	X Groundwater sampling
___ Soil gas surveys	X In-situ groundwater sampling
X Surface water and sediment sampling	___ Aquifer testing
X Surface soil sampling	X Hydrogeologic measurements
___ Soil boring installation	___ Biota sampling
___ Subsurface soil sampling	___ Trenching
X Monitoring well installation and development	___ Land surveying
___ Monitoring well abandonment	X Investigation derived waste sampling
	X Decontamination
	___ Other_____

2. Field measurements to be taken:

X temperature	X surveying
X pH	X magnetometry
X dissolved oxygen	X global positioning system
X turbidity	___ soil gas parameters (list):
X specific conductance	___ combustible gases
X organic vapor monitoring	X water-level measurements
X geophysical parameters (list):	___ pumping rate
X electromagnetic induction	___ other_____
___ ground-penetrating radar	

3. Sampling program (nomenclature, etc.):

___ As per Section 3.1 of Master FSP	X Other: As presented in the RI/FS Workplan.

4. Map of boring and sampling locations (attach to checklist): See Workplan.

5. Table of field samples to be collected: See RI/FS Workplan.

6. Applicable SOPs (attach to checklist) or references to specific pages in Master FSP: The following SOPs from the Master Project Plans are to be implemented:

- Shallow Soil Sampling
- Soil Sampling
- Soil Boring Sampling Split-Spoon
- Surface Water Sampling
- Sediment Sampling
- Groundwater Sampling From Monitoring Wells
- Low-Flow Groundwater Sampling from Monitoring wells
- Monitoring Well Installation
- Homogenization of Soil and Sediment Samples
- VOC Sampling - Water
- Field Filtering
- Chain-of-Custody
- Packaging and Shipping Procedures
- Field Rinse Blank Preparation
- Soil Boring Drilling and Abandonment
- Water Level Measurements
- Logging of Soil Borings
- Decontamination of Personnel and Equipment
- Decontamination of Drilling Rigs and Equipment
- Disposal of Fluids and solids

7. Site-specific procedures or updates to protocols established in the Master FSP: Described in the RI/FS Workplan.

Site-Specific Health and Safety Plan

This checklist must be used in conjunction with the Master HASP. This checklist is intended for use by CH2M HILL employees only. All CH2M HILL employees performing tasks under this checklist must read and sign both this checklist and the Master HASP and agree to abide by their provisions (see EMPLOYEE SIGNOFF attached to the checklist.

Site: **NASD**

Location(s): SWMU and AOC Location Maps and Individual SWMU and AOC figures are included in the Workplan.

This document shall be maintained on site with the Master Health and Safety Plan. It will include as attachments from the Work Plan a site map and the site characterization and objectives for this site.

The procedures described in the Master Health and Safety Plan will be followed unless otherwise specified in this Site-Specific Health and Safety Plan.

1. HAZWOPER-Regulated Tasks

_____Test pit and excavation	X_____Groundwater sampling
X_____Soil boring installation	_____Aquifer testing
_____Geoprobe boring	X_____Hydrologic measurements
X_____Geophysical surveys	X_____Surface water sampling
X_____Hand augering	_____Biota sampling
X_____Subsurface soil sampling	X_____Investigation-derived waste (drum) sampling and disposal
X_____Surface soil sampling	_____Observation of loading of material for offsite disposal
_____Soil gas surveys	_____Oversight of remediation and construction
X_____Sediment sampling	_____Other_____
X_____Monitoring well/drive point installation	
_____Monitoring well abandonment	

2. Hazards of Concern: (Check as many as are applicable. Refer to Section 3 of Master H&S Plan for control measures):

X_____Heat stress	_____Confined space entry
X_____Cold stress	_____Trenches, excavations
_____Buried utilities, drums, tanks	_____Protruding objects
_____Inadequate illumination	_____Vehicle traffic
X_____Drilling	_____Ladders, scaffolds
_____Heavy equipment	_____Fire
X_____Working near water	X_____Working on water
_____Flying debris	X_____Bees or insects
_____Gas cylinders	X_____Poison ivy, oak, sumac
X_____Noise	X_____Ticks
X_____Slip, trip, or fall hazards	_____Radiological
X_____Back injury	_____Other_____

APPENDIX E-4 AOC J - FORMER STAGING AREA DISPOSAL SITE

3. Contaminants of Concern (List if known. Reduce Table 3.8 of the Master HASP to site-specific contaminants, add additional chemicals if necessary, and attach to this checklist):

Metals	VOCs	Pesticides
PNAs	SVOCs	

4. Personnel (List CH2M HILL field team members and telephone numbers):

Field team leader(s)	Erik Isern	
Site safety coordinator(s)	Erik Isern	
Field team members	TBD	

5. Contractors/Subcontractors

X Procedures as per Master HASP

X Other

Name: To be added		
Contact: To be added		
Telephone: To be added		

6. Level of personal protective equipment (PPE) required: D
Refer to Table 5.1 of Master HASP, CH2M HILL SOPs HS-07 and HS-08, and Respiratory Protection, Section 2 of the Site Safety Notebook.

7. Air monitoring instruments to be used:

X OVM 10.6	FID
CGI	Dust monitor
O_2	

8. Decontamination procedures:

As per Section 7 of Master HASP

X Other: As described in the RI/FS Workplan.

9. List any other deviations or variations from the Master HASP: None.

10. Emergency Response (Check that all names and numbers are correct on page 47 of Master HASP and attach corrected page to this checklist)

11. Map to hospital (Highlight route to hospital from site and attach to this checklist)

12. Emergency Contacts (Check that all names and numbers are correct on page 49 of Master HASP and attach corrected page to this checklist)

13. Approval. This prepared site-specific checklist must be approved by Mike Goldman/ATL or their authorized representative

Name_____**Title** Health and Safety Manager **Date**_____

(Signature will be include din the Final HASP)

14. Employee Signoff. All CH2M HILL employees working at the site must sign the attached Employee Signoff for the checklist as well as for the Master HASP.

APPENDIX E-4 AOC J - FORMER STAGING AREA DISPOSAL SITE

_____Site

HASP Checklist Employee Signoff

The employees listed below have been given a copy of this health and safety plan checklist, have read and understood it, and agree to abide by its provisions.

EMPLOYEE NAME	EMPLOYEE SIGNATURE AND DATE

Site-Specific Work Plan Checklist

This checklist supplements the Master Work Plan (WP) with site-specific information. Once completed for a specific project, it provides necessary quality assurance information for each investigation. It is to be taken into the field with the Master WP.

Site(s): **NASD**

1. Discussion of site background, previous investigations, and previous analytical results:

2. Description of site-specific geology, topography, water table elevation, and local direction of groundwater flow:

3. Map illustrating the area of investigation in relation to the entire Base:

4. Discussion of the field investigation and activities to be performed at the site, including methods, locations, and types of drilling, sampling, and analyses to be performed:

5. Map illustrating boring, well, and sample locations:

6. Description of the feasibility study tasks to be performed at the site:

7. Explanation of staff organization and task order management:

8. Task order schedule:

APPENDIX F

1

PCB ORGANIC ANALYSIS DATA SHEET

EPA Sample No.: MU6MW04

Lab Name: PEL Laboratories, Inc. Contract: Vieques

Lab Code: PEL Case No. SAS No: SDG No.: 2207027

Matrix: WATER Lab Sample ID: 220702701 Lab File ID: 27-01COF.D

Sample wt/vol: 910 Units: ML Date Received: 07/12/02

Concentrated Extract Volume: 10 Date Extracted: 07/15/02

Level:(low/med) LOW Date Analyzed: 07/18/02 Time: 2145

Percent Solids: 0 decanted: Dilution Factor: 1

Extraction: SEPF Station ID: Method: 8082

GPC Cleanup: (Y/N) N pH:

Column(1): XTI-5 ID: 0.53 (mm) Column(2): RTX-1701 ID: 0.53 (mm)

CONCENTRATION UNITS: UG/L

CAS NO.	*ANALYTE*	*RESULT*	*Q*
12674-11-2	Aroclor-1016	1.1	U
11096-82-5	Aroclor-1260	1.1	U
11104-28-2	Aroclor-1221	1.1	U
11141-16-5	Aroclor-1232	1.1	U
53469-21-9	Aroclor-1242	1.1	U
12672-29-6	Aroclor-1248	1.1	U
11097-69-1	Aroclor-1254	1.1	U

Lower value of the two columns reported as result

Method and Target List	Reporting Limit		Laboratory Specific MDLs		Screening Criteria			
Semivolatiles GEP-OLM04.2 LL-LCGC03.2	ug/Kg	ug/L	Solid mg/kg	Aqueous ug/L	Soil mg/kg	Sediment mg/Kg	Groundwater ug/L	Surfacewater ug/L
1,1'-Biphenyl	330	5	0.0022	1.03	35		30.42	
Acenaphthene	330	5	0.0019	0.28	20	0.016	36.50	
Acenaphthylene	330	5	0.0022	0.24				
Acetophenone	330	5	0.0031	0.848				
Anthracene	330	5	0.0021	0.34	10,000		182.50	
Atrazine	330	5	0.0037	0.646	7.8		0.30	
Benzaldehyde	330	5	0.0048	0.919	6156		365.00	
Benzo(a)anthracene	330	5	0.0026	0.24	2.1		0.09	
Benzo(a)pyrene	330	5	0.0021	0.22	0.21	0.43	0.01	
Benzo(b)fluoranthene	330	5	0.0016	0.24	2.1		0.09	
Benzo(g,h,i)perylene	330	5	0.0019	0.26				
Benzo(k)fluoranthene	330	5	0.0017	0.38	21.1		0.92	
bis(2-Chloroethoxy) methane	330	5	0.0026	0.36				
bis(2-Chloroethyl)ether	330	5	0.0033	0.34	0.55		0.01	
bis(2-Chloroisopropyl)ether	330	5	0.0033	0.22	7.4		0.27	
bis(2-Ethylhexyl)phthalate	330	5	0.0031	5.99	123		4.80	
Bromophenyl phenyl ether, 4-	330	5	0.0028	0.26				
Butyl benzyl phthalate	330	5	0.006	0.65	10,000		729.99	
Caprolactam	330	5	0.011	0.295	10,000		1824.97	
Carbazole	330	5	0.003	0.25	86.2		3.36	
Chloro-3-methylphenol, 4- (p-Chloro-m-cresol)	330	5	0.0031	0.82				
Chloroaniline, 4-	330	5	0.0025	0.35	246		14.60	
Chloronaphthalene, 2-	330	5	0.0022	0.42			48.67	
Chlorophenol, 2-	330	5	0.0027	0.31	23.6		3.04	
Chlorophenyl-phenyl ether, 4-	330	5	0.0022	0.36				
Chrysene	330	5	0.002	0.31	211		9.21	
Dibenz(a,h)anthracene	330	5	0.0029	0.56	0.21		0.01	
Dibenzofuran	330	5	0.002	0.22	313		2.43	
Dichlorobenzidine, 3,3'-	670	5	0.0041	1.22	3.8		0.15	
Dichlorophenol, 2,4-	330	5	0.0036	0.3	185		10.95	
Diethyl phthalate	330	5	0.002	0.38	100		2919.91	
Dimethyl phthalate	330	5	0.002	0.34	10,000		36486.68	
Dimethylphenol, 2,4-	330	5	0.0027	0.44	1231		73.00	
Di-n-butyl phthalate (Dibutyl phthalate)	330	5	0.0017	0.26	200		365.00	
Dinitro-2-methylphenol, 4,6-	990	20	0.052	0.81				
Dinitrophenol, 2,4-	990	20	0.0047	1.27	20		7.30	
Dinitrotoluene, 2,4-	330	5	0.0035	0.7	123		7.30	
Dinitrotoluene, 2,6-	330	5	0.0084	0.81	61.6		3.65	
Di-n-octyl phthalate	330	5	0.0017	3	2462		146.00	
Fluoranthene	330	5	0.0018	0.22	2200	0.6	146.00	
Fluorene	330	5	0.0018	0.36	2628		24.33	
Hexachlorobenzene	330	5	0.0029	0.38	1.1		0.04	
Hexachlorobutadiene	330	5	0.0033	1.1	22.1		0.86	
Hexachlorocyclopentadiene	330	5	0.0022	0.49	10		21.90	
Hexachloroethane	330	5	0.0035	1	123		4.80	
Indeno(1,2,3-cd)pyrene	330	5	0.0034	0.26	2.1		0.09	
Isophorone	330	5	0.0029	1.2	1814		70.77	
Methylnaphthalene, 2-	330	5	0.0027	0.28				
Methylphenol, 2- (o cresol)	330	5	0.0033	0.72	3078		182.50	

Method and Target List	Reporting Limit		Laboratory Specific MDLs		Screening Criteria			
Methylphenol, 4- (p cresol)	330	5	0.0032	0.28	308		18.25	
Naphthalene	330	5	0.0029	0.25	18.8	0.16	0.62	
Nitroaniline, 2- (o-)	990	20	0.0019	0.3	1.8		0.10	
Nitroaniline, 3- (m-)	990	20	0.0025	0.45				
Nitroaniline, 4- (p-)	990	20	0.0018	0.46				
Nitrobenzene	330	5	0.0022	0.34	10.3		0.34	
Nitrophenol, 2-	330	5	0.0024	0.7				
Nitrophenol, 4-	990	20	0.0077	3.73	7			
Nitrosodiphenylamine, n-	330	5	0.0025	0.34	352		13.72	
n-Nitroso-di-n-propylamine	330	5	0.0022	0.28	0.25		0.01	
Pentachlorophenol	990	20	0.0031	1.32	3		0.56	7.9
Phenanthrene	330	5	0.0017	0.26		0.24		
Phenol	330	5	0.0031	0.25	30		2189.95	
Pyrene	330	5	0.0022	0.54	2913	0.66	18.25	
Trichlorophenol, 2,4,5-	990	20	0.0028	0.39	9		365.00	
Trichlorophenol, 2,4,6-	330	5	0.0039	0.57	4		0.36	
Volatiles - CLP SOW (OLM04.2)	Soil ug/kg	Water ug/L						
1,1,1-Trichloroethane (1,1,1-TCA)	10	0.5	0.000067	0.26	120		317.17	
1,1,2,2-Tetrachloroethane	10	0.5	0.000047	0.17	0.93		0.06	
1,1,2-Trichloro-1,2,2-trifluoroethane	10	0.5	0.000089	0.27				
1,1,2-Trichloroethane (1,1,2-TCA)	10	0.5	0.000054	0.22	1.6		0.20	
1,1-Dichloroethane (1,1-DCA)	10	0.5	0.000069	0.14	174		81.11	
1,1-Dichloroethylene (1,1-DCE)	10	0.5	0.000077	0.22	41.3		33.88	
1,2,4-Trichlorobenzene	10	0.5	0.000062	0.14	20		19.44	
1,2-Dibromo-3-chloropropane	10	0.5	0.000061	0.36	2		0.05	
1,2-Dibromoethane	10	0.5	0.000072	0.21	0.028		0.00	
1,2-Dichlorobenzene	10	0.5	0.000053	0.14	37		37.01	
1,2-Dichloroethane (1,2-DCA)	10	0.5	0.000041	0.21	0.6		0.12	
1,2-Dichloropropane	10	0.5	0.000049	0.16	0.74		0.16	
1,3-Dichlorobenzene	10	0.5	0.00006	0.17	6.3		0.55	
1,4-Dichlorobenzene	10	0.5	0.000051	0.15	7.9		0.50	
2-Butanone (MEK)	10	5	0.00027	1	2710			
2-Hexanone	10	5	0.00012	0.31				
4-Methyl-2-pentanone (MBK)	10	5	0.00013	0.42	284			
Acetone	10	5	0.00028	1.9	604		60.83	
Benzene	10	0.5	0.000058	0.14	1.3		0.34	
Bromodichloromethane	10	0.5	0.000058	0.15	1.8		0.18	
Bromoform	10	0.5	0.000061	0.16	218		8.51	
Bromomethane	10	0.5	0.000077	0.44	1.3		0.87	
Carbon disulfide	10	0.5	0.000065	0.28	72		104.29	
Carbon tetrachloride	10	0.5	0.00008	0.22	0.55		0.17	
Chlorobenzene	10	0.5	0.000044	0.14	40		10.61	
Chloroethane	10	0.5	0.000058	0.35	6.5		4.64	
Chloroform	10	0.5	0.000055	0.13	11.7		6.17	
Chloromethane	10	0.5	0.000056	0.17	2.6		1.51	
cis-1,2-Dichloroethene	10	0.5	0.000077	0.18	14.6			
cis-1,3-Dichloropropene	10	0.5	0.000048	0.19				
Cyclohexane	10	0.5	0.000069	0.19	14		3467.50	
Dibromochloromethane	10	0.5	0.000041	0.24	2.6		0.13	
Dichlorodifluoromethane	10	0.5	0.000071	0.23	30.8		39.46	

Method and Target List	Reporting Limit		Laboratory Specific MDLs		Screening Criteria			
Ethylbenzene	10	0.5	0.000055	0.15	19.5		2.91	
Isopropylbenzene	10	0.5	0.00007	0.12				
Methyl acetate	10	0.5	0.00012	0.24	9153		608.33	
Methyl tert-Butyl ether	10	0.5	0.000058	0.18	157		13.31	
Methylcyclohexane	10	0.5	0.000066	0.19			521.72	
Methylene chloride	10	0.5	0.00008	0.13	20.5		4.28	
Styrene	10	0.5	0.000044	0.16	170		164.11	
Tetrachloroethylene (PCE)	10	0.5	0.000086	0.22	3.4		0.66	
Toluene	10	0.5	0.000051	0.11	52		72.34	
Total xylenes	10	0.5	0.00015	0.31	42		21.00	
trans-1,2-Dichloroethene	10	0.5	0.000063	0.14	23.5			
trans-1,3-Dichloropropene	10	0.5	0.000043	0.17				
Trichloroethene (TCE)	10	0.5	0.000057	0.21	0.11			
Trichlorofluoromethane	10	0.5	0.00008	0.28	200		128.82	
Vinyl Chloride	10	0.5	0.000071	0.19	0.75		0.02	
Pesticides and PCB's - CLP SOW (OLM04.2)	Soil ug/kg	Water ug/L						
4,4'-DDD	3.3	0.02	0.00013	0.04	10		0.28	
4,4'-DDE	3.3	0.02	0.000054	0.056	7		0.20	
4,4'-DDT	3.3	0.02	0.00019	0.044	7	0.0016	0.20	0.001
Aldrin	1.7	0.01	0.0001	0.02	0.1		0.00	
alpha-BHC	1.7	0.01	0.00011	0.012	0.36			
alpha-Chlordane	1.7	0.01	0.00011	0.022				0.004
Aroclor-1016	33	1	0.0011	0.02	21.2		0.96	0.014
Aroclor-1221	67	0.2	0.001	0.43	0.74		0.03	0.014
Aroclor-1232	33	0.4	0.0013	0.3	0.74		0.03	0.014
Aroclor-1242	33	0.2	0.00065	0.38	0.74		0.03	0.014
Aroclor-1248	33	0.2	0.00045	0.27	0.74		0.03	0.014
Aroclor-1254	33	0.2	0.00042	0.15	0.74		0.03	0.014
Aroclor-1260	33	0.2	0.00048	0.02	0.74		0.03	0.014
beta-BHC	1.7	0.01	0.00006	0.018	1.3			
delta-BHC	1.7	0.01	0.000072	0.058				
Dieldrin	3.3	0.02	0.000036	0.038	0.11		0.00	0.0019
Endosulfan I	1.7	0.01	0.000069	0.043	369			0.0087
Endosulfan II	3.3	0.02	0.000047	0.018				0.0087
Endosulfan sulfate	3.3	0.02	0.00025	0.022				
Endrin	3.3	0.02	0.000088	0.044	18.5		1.09	0.0023
Endrin aldehyde	3.3	0.02	0.00018	0.051				
Endrin ketone	3.3	0.02	0.00019	0.034				
gamma-BHC (Lindane)	1.7	0.01	0.00011	0.019	1.7			
gamma-Chlordane	1.7	0.01	0.00011	0.025	6.5			0.004
Heptachlor	1.7	0.01	0.0001	0.022	0.38		0.01	0.0036
Heptachlor epoxide	1.7	0.01	0.000078	0.025	0.19		0.01	0.0036
Methoxychlor	17	0.1	0.00026	0.03	308		3.65	0.03
PCBs - Total			0.0013	0.43	0.371	0.023	0.034	
Toxaphene	170	0.01	0.00056	0.31	1.6			0.0002
Explosives - SW846 8330	Soil ug/kg	Water ug/L						
1,3,5-Trinitrobenzene	250	5	0.12	0.11	1847			
1,3-Dinitrobenzene	250	5	0.064	0.13	6.2			
2,4,6-Trinitrotoluene	250	5	0.088	0.18	57.5			

Method and Target List	Reporting Limit		Laboratory Specific MDL's		Screening Criteria			
2,4-Dinitrotoluene	250	5	0.12	0.59	2.5			
2,6-Dinitrotoluene	250	5	0.099	0.73	2.5			
2-Nitrotoluene	250	5	0.11	0.49	100			
3-Nitrotoluene	250	5	0.071	1	100			
4-Nitrotoluene	250	5	0.068	0.56	100			
Hexahydro-1,3,5-trinitro-1,3,5-triazine	250	5	0.058	0.32			0.61	
Methyl-2,4,6-trinitrophenylnitramine	250	5	0.14	0.63				
Nitrobenzene	250	5	0.13	0.26	10.3		0.34	
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine	250	5	0.08	0.69			182.50	
Perchlorates (EPA 314.0 and 314.0M)	100	20			102		3.65	
Metals - CLP/SOW (ILM05.2)	Soil ug/kg	Water ug/L						
Aluminum	40	200	3.75	14.6	10,000		3649.87	
Antimony (RL may be lower for 7041 method)	12	60	0.104	1.97	5		1.46	
Arsenic	2	10	0.162	0.855	1.6	8.2	0.04	36
Barium	40	200	0.027	0.191	283		255.50	
Beryllium	1	5	0.0165	0.158	10		7.30	
Cadmium	1	5	0.0156	0.228	4	1.2	1.82	0.25
Calcium	1000	5000	4.47	25.5				
Chromium	2	10	0.037	0.566	0.4	81		74
Cobalt	10	50	0.0551	0.577	20		73.00	
Copper	5	25	0.157	0.74	60	34	146.00	3.1
Iron	20	100	3.13	14	10,000		1094.99	1000
Lead	0.6	3	0.146	1.43	40.5	47	0.00	2.5
Magnesium	1000	5000	4.51	7.62				
Manganese	3	15	0.0447	0.274	1946		87.60	
Mercury	0.04	0.2	0.00211	0.0162	0.00051	0.15	1.09	0.77
Nickel	8	40	0.0561	0.651	30	21	73.00	8.2
Potassium	1000	5000	5.04	55.2				
Selenium	1	5	0.286	2	0.21		18.25	5
Silver	2	10	0.0677	0.325	2		18.25	
Sodium	1000	5000	2.73	9.1				
Thallium	2	10	0.133	2.9	1		0.24	
Vanadium	10	50	0.0242	1.26	2		25.55	
Zinc	4	20	0.276	2.52	8.5	150	1094.99	81
General Chemistry		Water ug/L						
Anions by EPA 300.0								
Sulfate		1		500				
Chloride		1		200				
Nitrate		1		50			1000.00	
Nitrite		1		50			100.00	
Orthophosphate		1		20				
Alkalinity by EPA 310.1				1000				20,000
Bicarbonate		5		calculation				
Carbonate		5		calculation				
Hydroxide		5		calculation				
Soil and Groundwater Screening Criteria								

Method and Target List	Reporting Limit			Laboratory Specific MDLs			Screening Criteria			
from EPA Region 9 October 2002 PRG (HI 0.1)										
Surface Water - National Recommended Water										
Quality Criteria: 2002 USEPA Office of Water										
November 2002, EPA-822-R-02-047										
Sediment - Long, E.R., D.D. MacDonald, S.L. Smith										
and F.D. Calder, 1995 Incidence of Adverse										
Biological Effects Within Ranges of Chemical										
Concentrations in Marine and Estuarine										
Sediments. Environmental Management 19 (1): 81-97										
Low Level Organic CLP SOW - OLCO3.2										